SATELLITE EDUCATIONAL TELEVISION FOR INDIA: AN EXAMINATION OF ECONOMIC AND POLICY ASPECTS

by

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ABSTRACT

Title of the thesis: Satellite Educational Television for India: An Examination of Economic and Policy Aspects

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Submitted to the Department of Political Science on May 23, 1969, in partial fulfillment of the requirements for the degree of Master of Science.

This study begins with a review of Indian experience with TV as an instructional medium. Results of evaluations made of three Indian experiments are cited to show that the effectiveness of the medium is no longer in question, but what is more important is to understand how, under the particular conditions prevailing in India, it should be used so as to yield the best results. The insights gained from the Delhi Rural Agricultural TV Project in particular, are discussed in an attempt to answer this question. The nature of some of the urgent problems facing India and how TV could be used to help solve these problems are discussed next.

The appropriateness of a satellite system for India is examined to see the advantages as well as the unique problems caused by a satellite. The central problem posed by a satellite is, how a satellite with its ability to deliver the same signal to the whole country can meet the vastly heterogeneous needs of the country. The means of coping with this problem are indicated and the need for both localized program production as well as a satellite, is pointed out. The requirements and availability of inputs for undertaking a ~~satellite~~ TV project in India are surveyed, from which it is easily seen how most of the problems center around TV rather than around the satellite. A brief description of the proposed joint satellite instructional television experiment with NASA is also given. The characteristics of a satellite to meet Indian requirements are touched upon, without going into a detailed technical discussion.

The paper then proceeds to a systems analysis of four alternative strategies for providing nationwide TV coverage: terrestrial, direct broadcast, rebroadcast, and hybrid systems. Discounted total cost over a 20-year period is used as the economic yardstick for determining the least-cost alternative for a given level of 'effectiveness'. The four alternatives are ranked on the basis of certain other criteria as well, and it is concluded that a 'hybrid' system (of direct and rebroadcast) would be the most appropriate alternative for India. A brief description of the airborne television system is also included, pointing out that it is an attractive interim alternative.

Finally, the following important public policy issues are discussed: the relative roles of TV and radio, rural versus urban location of transmitters, policy for TV receivers, Central and state control, organization and management problems, financing and foreign collaboration.

Thesis supervisor: Eugene B. Skolnikoff
Title: Professor of Political Science

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My special thanks are due to Professor Wilbur Schramm and Professor Lyle Nelson, of Stanford University, for their kind permission to quote and draw from their most thorough study, prepared for the U.S. Agency for International Development.

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Cambridge, Massachusetts
May 1969

Prasad L. Vepa

PREFACE

It is not customary for most theses here to have a 'Preface'. However, the rather different circumstances in this case seem to call for one.

At the outset it should be pointed out that, as the title suggests, the thesis is a broad-brush treatment of the economic and public-policy aspects of satellite television. A conscious choice has been made in deciding the areas on which the emphasis of discussion would be. Technical aspects of satellites and social consequences of television, though important, have not been dealt with, except in a cursory manner. The former has been studied in great detail by many others and is somewhat beyond my direct interest and competence. The latter has not been studied at all in the Indian context and discussion of it would be largely conjectural, in the absence of any empirical data.

Two questions which have a direct and important bearing on the economic analysis are the detailed costs of: 1. a terrestrial system using 1,000-foot antenna masts, and 2. an airborne system to meet the special needs of India. Despite my intention to examine these two systems, for lack of information and reliable data, this could not be done. There are strong reasons to believe that both these systems are potentially very interesting and attractive for India, and therefore merit serious attention and study.

Writing a thesis on a current topic like the one I have chosen, has at once advantages as well as dangers. Because of its relevance to an important project under consideration of the Indian Government, there is an unusual interest in the subject, and so it is personally very satisfying to make a study of it. The hitch, however, is that being a contemporary issue, it cannot offer the more sobering insights which require the perspective of time.

The opportunity of having been personally associated with much of what is talked about in this thesis is also a double-edged sword. While this association has given me a first-hand feel, and insights which I could not have gained otherwise, it naturally produces some biases too. But this handicap has put a greater responsibility on me to strive to be more objective. I realize, however, that the biases do surface here and there, and it would be less than honest to pretend that they do not exist. Spending one academic year here, at M.I.T., detached from my activity in India has partly compensated for this and helped me see issues in a clearer light. Those of my colleagues in India and others who were aware of my views on many of the questions discussed, would perhaps be surprised to notice some of the changes they have undergone.

Lastly, I cannot overemphasize the fact that this thesis is written purely as an academic exercise and is not to be construed as a criticism of any individual, organization or Government in general, either in India or in the U.S. In keeping with the freedom of opinion and expression that goes with academic pursuit, the thesis is frank; perhaps too candid in some places. However, I repeat, the criticism expressed is in good faith, and as a concerned Indian.

I would appreciate it if my attention is drawn to possible inaccuracies or errors in this presentation, and would be most grateful to have criticism or suggestions from readers.

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Prasad L. Vepa

TABLE OF CONTENTS

CHAPTER 1

INDIAN EXPERIENCE WITH TELEVISION

1.1 Introduction

The proposed satellite television project in India represents one of the most significant attempts in a developing country to use sophisticated technology for accelerating the social, economic and political development of a nation. The proposal, in essence, is to use a synchronous satellite for providing a nationwide television service, primarily for disseminating instructional and educational programs. The interest and attention focused on the subject, both in India as well as abroad, is simply phenomenal, as the growing number of studies show (References 1, 7, 22, 28, 29, 30, 35, 36, 37, 38, 39, and 40, listed in the bibliography). The matter has been receiving serious attention in the Indian Government, involving studies by a large number of people, drawn from various organizations. There is great interest in the U. S. also in such a proposal for India, both among scholars and in official circles. NASA has been studying the possibility of such a project for a long time and a Joint Study Group was established in 1967, consisting of officials from NASA and the Indian Government, to study the feasibility and nature of a possible joint satellite instructional television experiment in India, utilizing the proposed ATS-F satellite to be launched by NASA in 1972/1973. Also indicative of U. S. interest in the matter is the study contracted with the Stanford Research Institute in March 1968 by the U. S. Agency for International Development in support of the President's Task Force on Communications Policy, to study educational aspects of communication satellites for developing countries. The thesis will draw considerably from this excellent and most thorough study of the subject made by Professors Wilbur Schramm and Lyle Nelson, for the U.S.A.I.D.[1] What has captured the imagination of people both in India and the U.S. is the potential of television in revolutionizing the development of the country, particularly by the possibility of serving the needs of the isolated, illiterate and under-privileged rural masses. Before discussing the problems and prospects of satellite television for India, it would be useful to review and analyze Indian experience in using television so far.

1.2 Development and present status of television in India

There is only one small television station in the country, located in New Delhi, operated by All India Radio (AIR), the wholly Government-owned and controlled broadcasting organization which, by statute, has been given the authority for exclusive operation of radio and television broadcasting services. This was started in September 1959 as an experimental unit with a small, 5 KW transmitter, limited studio facilities and an antenna of only 80-foot height, giving Class A coverage to an area of slightly over 20 miles in radius. The Delhi station puts out programs for a total of 21 hours a week which include newscasts, cultural, public affairs and entertainment programs, besides social education, school and rural telecasts. Almost half the total time is devoted to school programs. The general service in the evenings lasts for about 90 minutes a day during the week and somewhat longer during the weekend; feature films are screened once a fortnight. Most of the telecasts are in Hindi, occasional talks, discussions and interviews being in English. There are about 7,000 home television receivers in Delhi, 540 in schools, with urban teleclubs organized in 217 of these, and 80 sets in village teleclubs around Delhi. Individual owners of home-television sets pay an annual license fee of $4.67 (Rs.35), and there is no commercial advertising on television as yet. Though the Delhi television station was started to gain experience before expanding the service further in the country, during the past ten years neither the coverage of the Delhi station was increased, nor was a station established anywhere else in the country. The antenna height of the Delhi station is soon expected to be increased to 250 feet when the radius of coverage would extend to about 35 miles.

Many people are intrigued as to why a country as large as India, which possesses a relatively developed industrial base, has not embarked on television much earlier and more vigorously. As there is no clear policy on television spelled out as yet, one can only surmise the reasons for this situation. The main reason seems to be that hitherto the Government has viewed television as an entertainment medium, and, therefore, has been reluctant to give it enough priority among other competing demands, to justify the investment involved. A second reason, which is true in some other developing countries as well, is a general skepticism of its utility. It is feared that it may prove to be disruptive, by fostering not merely a 'revolution of rising expectations', but also one of rising frustrations, if the means and opportunities are not provided by the Government to achieve the levels of expectation of the people.

Two committees were appointed by the Government to study and report on what the future of television in India ought to be:

1. The Technical Committee on Television, headed by Dr. S. Bhagvantam, Scientific Adviser to the Defense Minister, in 1965, and

2. The Chanda Committee, consisting of five members of Parliament and five distinguished public figures and senior officials.

The reports of both these committees recommended the establishment of television stations in all the major cities and the creation of a new autonomous corporation in the public-sector for the operation of television.[2, 3] But the Government has not so far taken action in the matter.

1.3 All India Radio's future plans for television

AIR had prepared an elaborate three-stage plan for the expansion of ground-based television in the country and has been pushing hard for its implementation by the Government.[4]

The first phase of this plan, at an estimated capital cost of $5 million, envisages the setting up of four new VHF stations with limited studio facilities, to begin with, in Bombay, Calcutta, Madras, and Kanpur (or Lucknow) during 1969-1974 (i.e. the revised Fourth Five Year Plan period), in addition to the expansion of the Delhi station. In the second phase, to be undertaken during the Fifth Plan period (1974-1979), studio facilities are to be expanded so that Delhi, Bombay, Calcutta and Madras would be Type I stations (i.e. major production centers with four studios), Kanpur would be a Type II station (i.e. two studios), and in addition 11 Type III stations (i.e. limited production with only one studio), and 15 relay stations, with no studios, would be established, at a total capital cost of $107 million for this phase. This would place a television station in each state capital and all the centrally administered territories (i.e. Delhi, Goa, Pondicherry, etc.). The third phase to be implemented in the Sixth Five Year Plan period (1979-1984), at a total capital cost of $67 million, envisages the addition of 30 more Type III stations and two Type II stations. The total capital cost of the AIR plan, exclusive of the cost of microwave links, is $179 million and is to be completed, hopefully, in 15 years.

Even though the AIR plan emphasizes the coverage of populous urban areas, it is estimated that this plan covers only 19% of the total area and 25% of the total population of the country. The Government has been silent on the matter of expansion of television so far, but is expected to reconsider the whole question in the light of the possibilities opened up by communication satellites. Early approval of Phase I and eventual approval of Phase II, however, seems quite likely, since it is virtually impossible for the Central Government to continue for long the denial of at least one television station for each state. As a special case, location of a television station in Srinagar, Kashmir, has already been sanctioned. Work has commenced and the station is expected to start functioning by the middle of 1970. The idea of having a television station in Kashmir was not heard of till the decision was announced last year. Very high priority has reportedly been accorded to its funding and the whole project appears to have been sanctioned for political rather than technical or economic reasons. This is not to imply that it is an unwise step, since there may be sound political reasons for it; the point is that it seems to be an ad hoc decision out of the blue, while the Government has been "seriously studying" AIR's plans and the Chanda Committee report for years.

1.4 Indian experience with television as an instructional medium

1.4.1 The School Television Project

Three significant and major experiments, or pilot projects, have been conducted so far by the Government to test the effectiveness of television for specific applications as an instructional medium. The terms "educational" and "instructional" are used interchangeably throughout this paper, though many people make a distinction between ETV and ITV, restricting the former to describe only school use and the latter to include all kinds of instruction.

The first experiment was the School Television Project, started in October 1961, just two years after the Delhi station came into being, with a Ford Foundation grant for the purchase of the television sets and for the evaluation of the project. The aim of the project was to see how television could be used to improve the standard of teaching in Delhi, which, like virtually every other place in the country, is handicapped by a shortage of trained teachers, laboratory equipment and other facilities. The idea of using television to share excellence and scarce resources was, therefore, very appealing. Considerable preparation and planning went into this project and close and full cooperation of the Delhi Education Department was secured.[5] Workshop sessions organized by AIR were attended by 700 teachers and 300 principals. This involvement of the teachers was very helpful not only in working out the details of the television lessons, but also in enlisting the whole-hearted support of the teachers right from the beginning. Also, constant interaction between the classroom and television-teachers is maintained through various meetings. The telecasts were not "enrichment" programs, but formed a part of the regular curriculum. Initially, the lessons were telecast to a single class level, but gradually all the six classes (VI to XI) at the high school level were covered. Television sets have been installed in about 540 schools in the Delhi area and about 200,000 students in all benefit from these programs. Six twenty-minute lessons are telecast every working day and AIR maintains close and constant liaison with the schools through periodic meetings and visits. AIR sends printed material to the schools to go along with the television lessons, and receives feedback from the schools in the form of evaluation reports. A comprehensive and large-scale evaluation of the project was undertaken in 1965 by Prof. Paul Neurath of New York, who was, incidentally, also responsible for the evaluation of the Radio Rural Forum experiment in 1956. His report observed that students were learning more and better with television than without television.[5] The overall difference between schools with and without television, as measured by performance of students at examinations, was small but significant. The school telecasts continue as a part of AIR's regular transmissions.

1.4.2 AIR-Unesco Pilot Project on Social Education through TV

The second experiment initiated in 1962, was sponsored by Unesco to test the effectiveness of television for social-education. A special series of twelve telecasts were made on a variety of topics like rights and responsibilities of citizens in a democracy, road safety, diet, health and hygiene, etc., meant for the common-man in the city. Teleclubs were organized in 217 of the 540 schools in Delhi where television sets had already been installed, and these were thrown open to the public for viewing the general service transmissions in the evenings. A systematic survey of the members of the tele-clubs found the programs to be effective, in terms of knowledge relating to those programs, and social-education telecasts also continue to be made by AIR.[6]

1.4.3 The Delhi Pilot Rural Agricultural Television Project

This project is discussed in some detail here because of its particular relevance to a national system of instructional television. In many ways, it is a model or a fore-runner of a larger system and is India's first and only experience of using television in a rural area to help implement specific development tasks of the Government like increasing food production. While studies made by the Indian National Committee for Space Research (INCOSPAR), of the Department of Atomic Energy, indicated that a synchronous satellite system is superior to a terrestrial system of providing television coverage, there was no experience in India in the use of television as an instructional medium for rural audiences.[7] Clearly, the problems in using the medium must be well understood for its effective exploitation on a larger scale through the use of satellites. Therefore, to test the effectiveness of television in disseminating information on improved agricultural techniques to villagers and to gain insights into the social and organizational problems of using television for developmental tasks, a pilot project was initiated by INCOSPAR in 80 villages in the Delhi area in January 1967.

The subject chosen for experimentation in this project was agriculture, the reason being that providing adequate food to the people is the country's No. 1 problem. While the scope for bringing more area under cultivation is rather limited, the only way to increase the yield seemed to be through an intelligent application of new and improved agricultural techniques. This is also in keeping with the Government's 'intensive strategy'. Significant strides have been taken in India as well as abroad, particularly in evolving high-yielding strains of seeds and in devising new techniques suited to them. The big problem, however, has been in communicating this information to the millions of farmers in the villages. The low rate of literacy and the relative isolation of rural areas due to lack of adequate means of communications have compounded this problem.

The project was inaugurated by Prime-Minister Indira Gandhi, who was formerly Minister for Information and Broadcasting, and is known to have a keen interest in this field. The effort was a joint venture of four different government agencies: INCOSPAR, which initiated the project, provided the television sets and was responsible for its design and coordination; AIR, which produced the programs; the Indian Agricultural Research Institute (IARI), which provided information and advice on new techniques in agriculture; and the Delhi Administration, which was responsible for organizing teleclubs in the villages and for taking follow-up action related to the telecasts.[8]

The project was started in the Delhi area even though it is not really rural, since the only television station in the country is located in Delhi. The choice of the individual villages for installation of sets was largely determined by their agricultural potential and progressive character, besides electrification and availability of proper facilities for community viewing. Twenty sets were retained for standby and monitoring purposes. The sets were imported ones and cost about $250 each.

Twenty-minute, biweekly telecasts in Hindi under the program title 'Krishi Darshan' (literally meaning agricultural view) were made on improved agricultural techniques. Teleclubs, consisting of about 20 interested farmers, were organized in each of the villages where sets had been installed. It was hoped that the teleclubs, constituted as viewing-cum-discussion groups would make the telecasts more effective in terms of end-results. Besides an elder man of the community serving as the Chairman, each teleclub also had a 'convenor', who was often the government agricultural extension worker of the village, called VLW (village level worker). It was his responsibility to take care of the television set, to initiate post-viewing discussions and to provide feedback to AIR in the form of discussion reports, queries and suggestions.

To facilitate immediate post-viewing discussions, the 'Krishi Darshan' programs are telecast as the last part of the day's transmission. While others in the village also view the telecasts, the members of the teleclub constitute a permanent core audience, out of whom are selected the respondents for the evaluation surveys. The usual 'Krishi Darshan' program depicts a dialogue between two farmers, one interested, but uninitiated, and the other familiar with the new techniques. Queries from teleclubs are answered at the beginning of the program and there is some light entertainment at the end.

A systematic field evaluation of the effectiveness of the programs was undertaken by the Department of Adult Education of the National Council of Educational Research and Training (NCERT), New Delhi, an independent organization. This evaluation was conducted a year after the project was started and was restricted to seven programs. All the respondents in the study were farmers. In the absence of a benchmark survey which would be necessary if a before-and-after study were to be done, it was decided to study the differences in knowledge, attitudes and adoption of new practices between farmers who had watched the programs (experimental group) and those who had not (control group) to see if they are statistically significant. The experimental group consisted of 100 respondents selected randomly, from among those members of the teleclubs who had seen all the seven programs under consideration. The control group consisted of 100 farmers drawn by stratified random selection from villages with no television sets and consequently not exposed to these prorams. An equal number of respondents from both the groups were selected belonging to different categories of size of land holding, and level of educational attainment, since it was felt that both these factors could have an influence on the respondents' awareness, attitude and adoption of new agricultural techniques. Extension services were fairly uniform in all the villages in this area so that respondents of both the groups were equally exposed to agricultural demonstrations, films, etc. Pre-tested questionnaires were administered to the respondents and data was usually collected through personal interviews.

The differences in the knowledge, attitudes and adoption of experimental and control groups relating to select programs were tested by 'chi-square' and 't' tests and it was found that these differences were significant at one percent level except for those practices which had already been popularized by means other than television.[8] Respondents of both the groups were classified under three different levels of education and the analysis revealed that at each level of educational attainment, respondents of the experimental group had significantly greater knowledge, a more favorable attitude towards improved farm practices and also adopted them to a greater extent than their counterparts in the control group.

This is the first systematic evaluation undertaken in India of the effectiveness of instructional television for rural audiences and shows rather convincingly the potential of the medium. The evaluation was of considerable value in dispelling some of the skepticism in India of the utility of television. It is, however, important to point out that all that one can infer is that television can be effective; it does not follow that it always will be. Therefore, the question to be asked is, how should it be used to yield the best results and what are the pitfalls to be avoided? The second objective of the project, which is perhaps more important than the first, addresses itself to this very question. The discussion that follows points out these problems and the insights gained from the experience with this project. It must be added that based on this feedback, the project has been subsequently reorganized, remedying many of the mistakes. It is also learned that it is now running far more satisfactorily.

The discussion that follows, about the problems relating to the project, would seem apparently contradictory to the conclusions of the field evaluation. However, this does not constitute an inconsistency for the following two reasons. Firstly, the problems cited are examples and it would be erroneous to infer that the situation is equally bad in all the 80 villages. Secondly, by the time the evaluation was conducted the medium had obviously still considerable novelty and the problem of losing audience was experienced only subsequently.

1.5 Insights gained from the Rural Television Project

1.5.1 Programming problems

Programming problems proved to be important eye-openers. Though programs are produced in a short time, on a shoe-string budget and under great handicaps, particularly with regard to equipment like cameras and transportation required for outdoor filming, the style of presentation involving a dialogue between two farmers has apparently proved to be stereo-typed and monotonous: it was found in some villages that people got bored and started chatting and even left, as soon as 'Krishi Darshan' was on the air.

The format used made the programs more aural and less visual and did not exploit fully the potential of the medium. There is a great need to experiment more freely with different styles of presentation, a suggestion difficult for AIR, which many people believe is characterized by inflexible management, and unimaginative programming, and by what it believes to be a purist tradition, to accept. It appears worthwhile to experiment with animated cartoons, the 'spot' format, and a variety of styles of presentation. Successful cartoon films have been made for programs like agriculture and even family planning in other countries; the technique merits consideration. It is rather ironical that new and improved agricultural methods are shown through old programming techniques (borrowed from sound broadcasting for villagers' programs). Innovation should apply equally to the medium as to the message. Since the hard core of a typical 'Krishi Darshan' program takes less than five minutes, it seems that the spot format could be used to advantage. The instructional material can be introduced much like commercial advertising spots, during entertainment programs such as feature films and plays, which have proved very popular. Since the novelty of the medium has almost worn off, judging from the attendance, attracting and retaining audiences has become a real problem and, therefore, the need for trying out new programming styles is all the more heightened now.

Initially, in most villages, the entire population showed up to watch television every day. Though reliable attendance records are not kept, it is estimated that after about a year, the figure dropped to about 20 to 50 people, and on an average, perhaps 50% of the 20 teleclub members watch any 'Krishi Darshan' program. Surprise visits to villages revealed that the set is sometimes turned off when 'Krishi Darshan' is on the air. Both urban and rural audiences have always been clamoring for more entertainment, as indicated by the survey conducted by the Listener Research Officer of AIR.[10] The preference of viewers for entertainment programs is a hard reality which one cannot wish away but has to contend with and capitalize upon. It is true that many people mentally condition themselves to blank out spot commercials on television, but, as we all know, due to repetition and skillful and subtle appeals, most people's purchasing behavior is, in fact, influenced by television commercials. Otherwise there would not be any. Yet another merit of the spot technique is that the cost of programming is much lower for it.

AIR feels that the resources currently devoted for these programs are grossly inadequate, and with more money, men and material, the quality of the programs would improve substantially. While such 'improved' quality may please the producers and sophisticated urban audiences, it is not clear if it would capture the attention of the villagers enough to make them keep the sets on. It is not being suggested that the present style should be completely done away with. The point is that the programming should be innovative, since no single technique will be good for all situations or for all time to come.

1.5.2 Teleclubs

Yet another problem which has great significance for a satellite project is that of teleclubs. Teleclubs were organized since it was felt that television would be more effective when reinforced by an individual at the viewing end. This assumption has been established to be valid for school broadcasts, where television is really an aid to the teacher, without whom it is of rather limited value.[5] Unlike the classroom situation, where the teacher plays the major role, and television a secondary one, in a rural teleclub, television would seem to play the major role and the convenor of the teleclub a secondary role, to clarify doubts and to anwer queries on the spot. Field officials involved in the project admit that discussions rarely take place in the teleclubs at the conclusion of the telecasts. However, when any important official visitor goes to a teleclub, an excellent discussion can be witnessed, which is a predictable experience of a 'conducted tour'. Unfortunately, the number of such model villages seems to be rather small and most visitors are taken to the same few villages. Apparently such discussions are 'staged' and not genuine or frequent. Experience with the 80 teleclubs showed that it is not realistic to expect farmers to sit around after everybody else has left to discuss the telecast for some 30 odd minutes.[8] It is somewhat hard to pin-point and tell why discussions rarely take place, but the main reason seems to be that farmers are neither accustomed to nor articulate enough to express their opinions to discuss freely in a group situation.

Social tradition and custom is also a barrier for the functioning of the teleclub. As an institutional mechanism of initiating change, it is totally new to the Indian rural scene. Deference to authority, elders, officials, village leaders, caste superiors, wealthier members of the community, etc., makes it difficult for an ordinary, average farmer to speak up and air his views or disagree with what is said or shown on television, particularly in the presence of the government village level worker, or other higher extension officials who sometimes visit the teleclubs, or the 'Sarpanch' (head of the village council). There are always exceptions of farmers who are confident, opinionated and articulate. It is not being suggested, therefore, that one should forget about discussions in teleclubs. This only shows the great need to increase our understanding of the village group-dynamics, by undertaking appropriate social, anthropological and behavioral research. The essential task of television is to initiate change, and the teleclub was hoped to function as a catalytic instrument to facilitate the process of change. It is therefore necessary to understand the dynamics of change. The concept of the teleclub grew out of Kurt Lewin's experiments in the U.K. showing that adoption of an innovation advocated in mass media depends upon inter-personal discussion of it.[11] As shown in Canada, 'Forums', like teleclubs, can change "group-anchored attitudes and behavior, because the discussion permits an entire group to change without requiring an individual to deviate from the group".[12] It should be noted that these examples citing the effectiveness of the forum or teleclub concept, are taken from Canada, U.K., and France, where the socio-economic and cultural situation as well as educational standards are very different from that of rural India. The whole issue of teleclubs has not been given enough attention even though it is a key element in the whole process. One idea which merits experimentation is to show successful teleclubs in action, on television, so that the idea of discussion is accepted. This could become a frequent feature with different teleclubs being shown on television, so that people are motivated to discuss and are kept guessing as to when their particular teleclub would be on the air. Considerable research, imagination and experimentation is called for to make the teleclubs accomplish the function that is expected of them.

Another related question is that of feedback from the teleclubs. The number of discussion reports received by AIR from the teleclubs is very small and much of this so-called feedback is of no value, as many of the reports are suspected to be rigged. However, there are about a dozen letters, on an average, per program, written voluntarily by individuals giving their comments and often constructive criticism relating to the programs. It is such voluntary and genuine feedback that AIR values, as it is useful to its producers.

Payment of honoraria to convenors of teleclubs has always been a thorny problem. It is said that discussion reports are not sent in sufficiently large numbers now because the convenors are not paid any honoraria for their work in the teleclubs. This seems to be more of an alibi and one is not sure if the situation would change just by paying them money. Since these reports are of dubious value anyway, they should not be insisted at all, which would also deflate the honoraria issue. The job of a village level worker is primarily agricultural extension and television should be looked upon as an aid to him and not as a burden. It would be a costly mistake if, following the unfortunate precedent set in the urban teleclubs, honoraria is paid to the convenors of rural teleclubs: it would cost the Government about $13.3 million (or Rs.100 million) a year for a national system, if the monthly honorarium is $2 per head. Once television is used more widely, their job would have to be restructured with considerable emphasis on television, and perhaps altered working hours during the day to compensate for their duties with television in the evenings. For a fraction of the amount required for paying honoraria to the convenors, it should be possible to get an on-going evaluation made on a random sample basis and to provide that feedback to AIR. It must be recognized that some kind of meaningful and quick feedback on the programs would be very useful for AIR to have. The dozen-odd letters are clearly inadequate and the need is perhaps best met by having a continual evaluation on the presentation of the programs, made in a systematic way. A fortnightly survey has been proposed by the Department of Adult Education of the NCERT to meet this need.

1.5.3 Maintenance of receivers

The problem of maintenance encountered with this project clearly emphasized the need to make adequate arrangements for prompt repair of the sets if a larger system using a satellite comes into being. During the first year maintenance of the village television sets was virtually non-existent, since the supplier was neither equipped nor interested in discharging the free one-year service guarantee. It was unrealistic in the first place to expect anything else from an ill-equipped middle-man. It was estimated that, on the average, 10% of the sets were not working at any given time and the figure rose to as high as 20% during the worst period in the monsoon season.[8] This has understandably caused considerable bitterness and frustration in many of the villages. The sets should have been procured directly by the Government and a service unit with trained technicians, equipment and transport facilities should have been detailed for this project to undertake regular pre-ventive as well as remedial maintenance. Currently, AIR has been entrusted with the responsibility of maintenance and the situation has improved substantially since AIR has trained technicians and equipment to do the job, though it is handi-capped for want of transport facilities. This arrangement of a broadcasting organization undertaking receiver maintenance is an unusual one, but seems to be working well and the fraction of sets out of order is now reported to be down to 1 or 2%. However, a different and more elaborate set-up would be required for receiver maintenance for a larger system.

1.5.4 Management of the project

This project has raised doubts about the ability of the Government to organize inter-ministerial ventures of this nature. The first problem here was the lack of adequate interest and willingness to support the project. Few of the concerned policy-makers and high officials paid more than lip-service when the idea was first mooted. It is true that lack of resources is a severe constraint, but it should have been possible particularly for the Ministry of Information and Broadcasting, the Ministry of Food and Agriculture, and the Delhi Administration to sanction at least some funds, if not their fair share of inputs required for the project. One would have expected the first two organizations to initiate the project and fund the capital expenditure (purchase of television sets, primarily), since it falls directly within their purview. Instead, the Food Ministry reportedly took the stand that radio is quite adequate for agricultural extension and it could do without television for the foreseeable future, and the other two organizations did not have "adequate funds". The project could not have been started but for the initiative and impetus of the Department of Atomic Energy (DAE). Not only were the sets bought by the DAE, but a considerable amount of operating and maintenance expenses are being borne by it. Even 18 months after starting the project, the Ministry of Information and Broadcasting had not sanctioned any additional funds or personnel to AIR for producing these programs. AIR has been able to undertake this additional work by stretching its resources and burdening its limited facilities.

Lack of managerial skills in Government organizations was also a serious problem. For example, it took 11 months to get television sets installed in 80 villages, most of which were already electrified (a few were supplied power to enable installation of sets), and easily accessible by road, being within a radius of 15 miles from Delhi, the seat of the Central Government. Coordination between the collaborating organizations was also poor despite - (or was it because of?) - the multiplicity of committees and meetings. It was clear that a committee cannot run a project like this. Responsibility was diffused and no single individual was in charge of the project, as authority was vested in a high-level committee of Secretaries of the various ministries involved. Often provision of physical inputs like seeds, fertilizers, insecticides, etc., did not coincide with the telecasts advocating their use, due to lack of coordination and supply bottlenecks and plain inefficiency in the Government. Complaints to this effect were heard from farmers on many occasions. The missionary zeal and support of a single individual or organization is not enough for the project to succeed when that dedication and commitment is not shared by the other collaborating organizations. It is essential, therefore, to enlist the wholehearted support of all the organizations right from the beginning.

CHAPTER 2

ENVISAGED USES OF TELEVISION IN INDIA

2.1 Experience with television abroad

Having discussed Indian experimentation with television so far, it would be useful to review the experience abroad. However, since the literature is replete with case studies in the use of television, in both developing and advanced countries, the review here would be done rather briefly, drawing from the Schramm-Nelson report, where this has been summarized.[1] Easily, the most extensive summary of research on instructional television is the work by Chu and Schramm, 'Learning from Television'.[13] An excellent series of case studies is contained in the three volumes, 'The New Media in Action: Case Studies for Planners'.[14] Though every country is unique in its own way, there are enough common problems that lessons learned abroad are of value for India too.

2.1.1 Effectiveness of television

As in the case of India, experience abroad also shows that television can be effective as a tool for education, but not necessarily is. Effectiveness depends upon how it is used. As Schramm points out in his paper presented at the U.N. Outer Space Conference, held in Vienna:[15]

> "There are approximately 1,000 research papers and a number of case studies dealing with instruction by television. The

> research says, in brief summary, that television can handle effectively any part of the teaching process that it can carry. It cannot very well conduct a class discussion, or listen to papers by the students it teaches, or counsel an individual. But it can share expository and explanatory teaching, and demonstrations. When excellence is anywhere available to a school system, it can share excellence. It can step into the gap when teachers are not highly trained, or not prepared to teach specialized subject matter; when visual aids are in short supply; when learning opportunities need to be brought to pupils who have no schools or cannot go to a school; when it is desired to provide in-service training for teachers, or to enrich the work of study groups in literacy or adult education."

As Stickell observes, these abilities have been well shown, but the research has revealed no significant difference in the learning result which is attributable to the method of delivery alone.[16] The finding of research abroad, as well as of the study done by Paul Neurath of the School Television Project in Delhi, that there is no significant difference in learning from television compared to face-to-face learning, does not go against television. In countries like India, the problem is one of acute shortage of trained teachers: about a third of the teachers have not had teacher-training, and while a million more are required over the next five years, only 70,000 are presently under training.[17]

2.1.2 Extent of use of ETV abroad

It has been estimated that the number of countries in all, using television in one way or the other for teaching exceeds fifty.[15] It is used in most parts of the world:

the U.S., Soviet Union, Western Europe and Japan are the advanced areas using ETV widely. Even among developing countries, its use is quite extensive: Niger, Nigeria, Algeria, Ivory Coast, Zambia, Senegal, Kenya, Uganda, Rhodesia, Sierra Leone, Egypt, Jordan, Turkey, Pakistan, Taiwan, Korea, Singapore, Jamaica, Colombia, Mexico, Venezuela, Peru, Brazil, Chile, Samoa, etc., besides India. And in these countries television has been put to use for: upgrading instruction, training teachers, extending the school, literacy and fundamental education, adult education and community development, remedial instruction, improvement of secondary schools, agriculture, and village development.[1] In many of these countries studies have been made in the use of television and, in general, the results from the developing countries are also quite encouraging.

2.2 Research findings on improving effectiveness of television

Drawing again from the Schramm-Nelson report, essentially, the following four points emerge from the research, on how the effectiveness might be maximized.

1. It is important that the technical quality of the television program should be good. The signal should be good and clear and there should be prompt technical maintenance of the receivers.

2. Interesting and skillful programming is vital for the medium to be effective. Television is a very demanding medium, and it is not enough to put a teacher or an agricultural extension worker in front of a television camera and let her, or him, just continue talking as usual. Careful preparation and planning is required

with more attention to visual materials, speed of exposition, review of key points, anticipation of questions, etc., in order to come across effectively on television.

3. Effectiveness depends upon the context in which television is used and what activities are built around it to enhance learning or implementation of what is taught. Television is rarely used by itself, in isolation, to do a teaching job; it is always built into a system. In the school, it includes the classroom teacher; for agricultural programs, it includes the agricultural extension worker and the process of group discussion in a teleclub.

4. Television is most successful when used to meet a specific felt need or problem rather than when it is used just because it is there. Niger and Samoa testify to this very eloquently; in both these instances where its use has been successful, there was an acute problem - a shortage of trained teachers and a desire to accelerate the process of development - which was recognized first and then the efforts went into harnessing television to meet the challenge.

2.3 Uses envisaged for television in India

In the absence of a clear Governmental policy regarding the question of television, what would be discussed here are the opportunities and the needs or problems for which television could be used to advantage. Even if the Government decides to go ahead with a national television project, the extent and timing of the deployment for various tasks would depend upon the evaluation made of the priorities attached to the solution of these problems. The order in which the suggested uses are listed here reflect the author's own assessment of what these priorities might be.

The Constitution of the country and the objectives laid out in the Five Year Plans indicate national goals of development, but they are too general to interpret into specific directives for purposes of analysis here, though they should be kept in mind as a general frame of reference. These goals are: ensuring democracy and secularism, elimination of poverty and creation of a 'socialistic pattern of society', and forging national integration. Three development goals are, however, clear: 1. provision of free and compulsory education for children to the age of 14; 2. strengthening of agriculture, and industry which would help agriculture, so as to attain self-sufficiency in food production as early as possible; and 3. mounting a massive nationwide family planning campaign.

It is useful to understand the setting under which television would be used in the country. In terms of size alone, the problems to be tackled by television are staggering. India has an area of about 1.26 million square miles and a population of around 530 million people, with 80% living in 567,000 villages, and a literacy rate of 24%. Perhaps the most challenging problem television would face is the cultural, economic, and geographic diversity and heterogeneity, coupled with the tradition-oriented attitudes in the country, characterized by a fatalist philosophy, a reluctance to change and emphasis on spiritual rather than material values.

2.3.1 National integration

This is perhaps the most important problem facing the government, since the issue is at the root of the country's viability as a single political entity. The long history of

India as one nation, the Hindu religion to which most of the people have always belonged, and the struggle for independence from the British rule were three great unifying forces in the country. The third factor is inoperative after independence, and the pressures and conflicts between various groups soon after independence, to maximize short-term political and economic benefits have clearly overshadowed the first two. Of course, in olden days, the mobility between places and interaction between groups was far less because, being a pre-industrial society, most communities were self-sufficient and transportation and communication facilities were less developed. As a result, there was not much scope for conflicts of the present type to take place. This is, however, a rather simple-minded hypothesis of a very complex phenomenon which can be well-analyzed only by future historians and social scientists, who will have the benefit of hindsight and a longer perspective of events. The fact however remains that despite all the cliche-ridden talk of 'unity amidst diversity in India', what one encounters increasingly these days is animosity amidst diversity. National unity was taken for granted till separatist and divisive forces raised their heads after Nehru, exploiting the language and cultural differences and sensitivities to reap vested political gains. This is an unfortunate, but perhaps foreseeable consequence of Nehru's plan of reorganizing the states on the basis of language. The virtually endless demands for the creation of new states, and the Government's acceding to these demands shows the Pandora's box that was opened. The riots which occurred in the South in 1965 only underline the serious schism between the North and the South on the language question. This has led even to a secessionist movement and an intensified effort to make the regional language occupy the most prominent position in each of the states, as a reaction to check the alleged imposition of Hindi by the Central Government. However, Hindi movies and their movie stars have an enormous popularity all over the country, and these movies have been a source of incidental learning of Hindi, particularly among the younger generation, in the non-Hindi speaking states. The universal popularity of Hindi movies in the country is an interesting phenomenon and ought to be taken advantage of by television as an effective integrating force and for a quicker spread of Hindi as a national language. The language question is a sensitive issue today in the country, and is likely to be so for quite some time to come, and it is beyond the scope of this paper to go into it in great detail. Suffice it to recognize that it is a key, if not the central, issue in the matter of national integration, and the potential of a powerful mass medium like television to help accelerate the acceptance and spread of a uniform national language is naturally of great interest in this connection.

The second issue relating to national integration is the rise to power of non-Congress Governments in many states since the last general elections of 1967. Though in principle this is good politically for a truly democratic country, in practice this could and does create problems. It is not hard to visualize the delays that would be caused because of differences in opinion between state and Central Governments with regard to taking decisions and implementing development plans. The political hues of the parties in power range from the extreme right (Jan Sangh party of Metropolitan Delhi), to the extreme left (pro-Peking Marxist Communist party, called United Front, which is in power in West Bengal). This spread in political persuasion of state Governments could impede national integration, in contrast to the situation when the Congress party was in power in all the states. Two years is too short a period, and only time can tell what the effect of this is on national integration. This is a question which should interest political and social scientists greatly.

A third problem which has assumed very serious proportions in the past two years is the growing popularity of blatantly parochial, militant movements like the 'Shiv Sena' in Bombay, which is a national disgrace. This group, or party, insists that people from outside the state have no place in Maharashtra. Harrassment and violence against businessmen who have established themselves in Bombay has made life very difficult and insecure for them in the premier metropolis and commercial capital of the country. Only a few months ago riots caused by 'Shiv Sena' members in Bombay led to the death of 52 people in police firings. As a predictable reaction to 'Shiv Sena' in Bombay, many other 'senas' have sprung up in other parts of the country. These 'senas' are a menacing threat to national integration.

The fourth problem relates to the division and distance that exists in reality, not only between the religions, but also within the Hindu religion itself, among various castes and sub-castes. According to the Constitution, India is a secular country and 'untouchability' or discrimination in any form against 'Harijans' and other 'scheduled' and 'backward' castes and tribes has been outlawed. While the Government has provided special opportunities and concessions, particularly for higher education and employment to them in order to equalize opportunities for their advancement in society, in many of the smaller towns and villages there is considerable bigotry, discrimination and prejudice against these minority groups, though this is slowly changing. There can be no real national integration unless the caste system is demolished - not merely by the Government, but by the masses.

There are many other impediments to national integration, but these four briefly described above, are the more serious hurdles. Solution to these problems involves essentially a change in attitudes which are deeply rooted in the fabric of Indian society. Education is of course vital for this, but it is a slow process, though here again, television has a big role to play. For a democracy to function meaningfully, increased involvement and political participation of the millions of illiterate and isolated rural masses is essential and for increased political participation, a national awareness and feeling of concern for the whole country, is a pre-requisite. And it is here that television has a unique role and potential by providing a timely and common base of information and experiences for the whole country. The faster spread of a national language, greater awareness of the people, the problems, and the progress of all parts of the country, increased familiarity with the images and ideas of the political leaders, are all very useful and important functions which television can contribute to in forging national integration. It is for this reason that an essential requirement of any television system in India is that it should have a national hookup facility for providing the same program to the whole country. It is felt that the timeliness and commonality of a national television program is of importance for national integration. However, the percentage of time for which the system would be used as a national hook-up would be rather small.

2.3.2 Family planning

The importance of family planning for India can hardly be over-emphasized. Population is easily the country's most crucial problem and is perhaps even more important than national integration. India's present population is over 530 million and it is the largest democracy in the world. The net addition to the country's population is about a million a month, or an annual growth rate of about 2.5 to 3%. Improved medical care, better sanitation and control of epidemics by the Government brought down the mortality rate, while the birth rate continued to be at a high level of 41 per 1000. A top priority target of the Government, therefore, is to bring the birth rate down to about 25 per 1000. Because of the expanding population, the economic growth of the country is hardly perceivable, since while the national income increased during the Third Plan period at an average of about 4%, the per capita income increased by only 1.5%.[18]

After a poor record for a long time, the Government has mounted a very concerted family planning campaign under the dynamic new Minister for Health and Family Planning, Mr. S. Chandrasekhar, and in the new Fourth Five Year Plan an allocation of $400 million (Rs.3,000 million), or 1.2% of the total outlay has been made for family planning. The magnitude of the problem is enormous, considering that the target audience is about 100 million couples in the reproductive age group of 15 to 45 years, while it is estimated that acceptance of family planning methods can be currently found in about 1% of this group.[1] The first task here is to sell the idea of the need to practice family planning to the target audience, and the second is to provide family planning services. A host of media are currently used to emphasize one simple, principal theme: 'two or three kids are enough; consult the doctor'. The sheer problem of logistics involved in reaching 567,000 villages makes it a Himalayan task even to spread the message, not to speak of making services and supplies available. The problem is compounded by the intimate nature of the information, and the tradition in the country, which shrouds the subject in secrecy. For this reason, television seems attractive primarily for creating an awareness and interest in family planning, by being able to jump the barriers of literacy and physical distances. This would have to be followed up immediately by personal advice and medical assistance and supplies. The big problem is time, since babies do not wait till television arrives! Even if it takes a few more years to introduce television, it still is more attractive than other media, though clearly, it would not be used exclusively. The Delhi station telecasts some programs now and then relating to family planning. Unfortunately, for lack of resources, a special series like the agricultural programs, could not be started on family planning.

2.3.3 Agricultural extension

India can be described as an agricultural country since 70% of her working force is involved in agriculture, contributing to half of the $32 billion gross national income.[7] The Government has been struggling hard to provide adequate food to the population and large amounts of money are spent for importing food grains, even though the food deficit, measured in percentage terms, is not large, being less than 10% of indigenous production.[18] In 1967 India had to import over $667 million (or over Rs.5 billion) worth of food grains, which is a considerable diversion of resources from economic development purposes. The reason for this situation is the very low yields due to antiquated methods of farming and a heavy dependence on unpredictable rains.

As mentioned in Chapter 1, while the scope for bringing more area under cultivation is rather limited and also not cost/effective, perhaps the only way to increase food production is to increase the yields of existing land under cultivation through an intelligent application of new techniques and an intensive use of resources. This, in essence, is the Government's 'intensive strategy' of selecting limited areas and applying heavy doses of inputs like high-yielding varieties of seeds, fertilizers, pesticides, and using modern techniques and equipment. This strategy, coupled with good rainfall, has paid off in the past two years and the acreage under the 'Intensive Agricultural Districts Program' is being increased every year, and hence the recent talk about the 'green revolution' in India.

Significant strides have been taken, notably at the Indian Agricultural Research Institute, New Delhi, as well as abroad, particularly in evolving high-yielding varieties of seeds and in devising new techniques suited for them. But this knowledge and information resides in research institutes and government departments; the problem is in disseminating this information to the millions of farmers in the villages. And it is here that television has an important role to play. The problem has two components: first, new techniques mean new and more information; second is a more subtle aspect of persuading farmers to change the methods they have been using for generations, and to adopt new practices. Television appears to be ideally suited for both these functions, since not only is it timely, but visual demonstrations of the results of adopting the new techniques can be very compelling and convincing. This is not to imply that other media have no place; a single picture of the results of one innovative and successful farmer can be far more persuasive than any number of pamphlets, radio-talks by experts or personal exhortations. Once an awareness and interest in new methods has been created by television, the farmer would need more information and help from agricultural extension workers (VLWs), and so, greater demands would be made on the time and expertise of the latter. This would mean that VLWs have to update their own information and be periodically retrained - a task which is greatly facilitated by television. There are currently about 40,000 VLWs, each serving 5 to 10 villages, and most of them are assigned to agricultural extension work. This field staff is grossly inadequate and many of them have not had the benefit of proper training.

As experience with the Delhi Project showed, television can and does provide useful and timely information to the farmers, unlike radio, which is handicapped by being purely aural, or unlike films which are too infrequent to be timely.[8] 'National agricultural demonstrations' are arranged periodically by the Government, but, once again, the problem is one of numbers and time. Providing up-to-date weather and market information is also of great importance to the farmer besides information on new agricultural methods.

2.3.4 Education

Provision of free and compulsory education to children up to the age of 14 is a goal written into the Directive Principles of State Policy of the Constitution. Therefore, in terms of budgetary allocation, education receives very high priority. Expenditure for 1965-1966 was about $1.33 billion (or Rs.6 billion, according to the pre-devaluation rate of exchange), and the amount that is being spent by the Government on education is more than doubling every ten years.[17] Allocation for the revised Fourth Plan is $1.06 billion (Rs. 8,020 million) or 3.3% of total allocation. It is estimated by Dr. J. P. Naik, Secretary of the Indian Education Commission of 1964-1966, that it would take another 15 to 20 years before the Constitutional goal of free and compulsory education to age 14 is achieved. The school population in that time would grow from 70 million to 170 million! The Education Commission stated the following primary goals for education:[17] 1. provision of equality of educational opportunity; 2. improving the quality of education and the cultivation of excellence; 3. relating education to productivity through programs of science education and increasing the vocational content of curricula; 4. contributing to national integration and 5. training of teachers.

Extending education

As the Schramm-Nelson report notes, this requires that: "1. dropouts be reduced; 2. new schools be established in many more villages (now about two-thirds of the habitations have primary schools, and many fewer have middle and secondary schools); 3. the middle secondary at least, must be greatly expanded (now only about 33% of the children in this age group are in school); 4. fundamental and specialized education for adults must be offered much more widely than it is now, and 5. the opportunities for university education must be enlarged."

Television lends itself very well to attack the problem of extending education because of its ability to motivate students and reduce dropouts, as experience in many countries has shown.[14] Also, television helps faster expansion of education and at a higher level of quality. Moreover, the combination of correspondence study with either radio or television has proved to be a very powerful and flexible method of expanding education.[1] Radio could and should be used for school programs, without having to wait for television, though it is not as effective as television except for language or music. Experience in the use of radio for school programs in India showed that it did not catch on, unlike television, and the teachers were "silently hostile" to it.[20] One survey showed that only 11% of schools equipped with radio used them regularly for school programs.[19] This, however, does not imply that radio is inappropriate for school teaching. Much less planning went into the School Radio Project and there was not the same kind of involvement of the classroom teachers, compared to the School Television Project. Also, a radio-teacher would be a rather poor competitor to an average teacher in the

Delhi area, whereas in a remote village the radio-teacher may not have a counterpart in the school at all! Therefore, there is a strong case for making a parallel and concerted effort with radio to expand school education, since like many other problems, this also cannot wait till television becomes available.

Improving the quality of education

In most schools in India instruction is dull and is dominated by out-dated practices with emphasis on memorizing facts and figures for examinations rather than encouraging individual initiative and problem-solving ability. Many reasons are cited to explain this situation: shortage of trained teachers, inability to attract higher quality people to the teaching profession because of the low salary levels, lack of proper books, laboratory facilities for science teaching, etc. An important factor which is somewhat overlooked is that the tradition of teaching in India puts the teacher on a high pedestal; he is supposed to know everything and is infallible, and he is not to be challenged or questioned back. Most Indian students in schools are overawed by their teachers, but by the time they are through with their first year in college, they realize how much their school-teachers did not know. The tradition of teaching has to change in a society which is trying to grow from a purely agricultural into a modern industrial economy. There is an urgent need not only to improve the quality of teachers, but also books and the curricula itself. The Education Commission has taken note of this and the National Council for Educational Research and Training, seized with this problem, has been supporting, among other things, the effort of preparing new text-books, and experimentation with new curricula.

In such a situation television has two significant contributions to make. First, it is unparalleled in its ability to share excellence and thus equalize opportunities for learning and also make up for a high fraction of untrained teachers. Seoond, the introduction of television would make it absolutely essential to revise and upgrade curricula and teaching materials and force the undertaking of this much-delayed step. Though other media also have a role to play, as the Delhi School Television Project showed, television can accomplish a lot in improving the quality of instruction, which would make a big difference to under-privileged schools in the smaller towns and villages.

Strengthening the vocational and technical component of education

The number of students who attend vocational courses at the secondary stage in India is only 12%, compared to 60% in Japan and 70% in West Germany.[21] Industrialization is held up for want of middle level technical personnel and the Education Commission has noted the need to mesh education with employment requirements and opportunities in the country. But the problem is that vocational education is more expensive than general education and vocational teachers are in very short supply. It is also essential to change the attitudes of students and their parents towards working with one's own hands in a factory rather than doing a white-collar job. Unemployment among the educated is astounding. In states like Kerala, where literacy and education is high and employment opportunities limited, people with even bachelor's degrees are known to take up jobs like that of a bus-conductor, which are usually held by those with little or no education at all. To increase the vocational component of education, science teaching at the lower levels needs to be strengthened. For science teaching as well as vocational teaching television seems well-suited in view of its ability to share excellence and to present demonstrations and experiments visually, which would be essential. Television can also help change attitudes towards blue-collar jobs just as career-guidance films do, but more easily than films.

2.3.5 Literacy teaching

It is hardly necessary to emphasize the importance of literacy for the development of the country. Without education, neither effective political participation in a democracy, nor economic growth through increased employment is possible. Also, many of the Government's programs of development are severely handicapped because of high illiteracy in the rural areas. According to the 1961 census, 24% of the total population of the country was illiterate. It is also estimated that about 60% of the people who enter the labor force each year are illiterate.[1]

Currently, about 500,000 adults between 15 and 45 are being made literate every year through Governmental programs of literacy classes, held at adult education centers, which is about 0.3% of the population in this group. But many of them lapse into illiteracy again due to lack of use of the newly acquired skill. It is for this reason that the Government now emphasizes programs of 'functional literacy', where the opportunity to learn the printed word is built into the process of literacy teaching. AIR had plans to introduce a regular series of programs for literacy teaching on television, but, as with the case of family planning, the project could not be started for want of funds. Television has been successfully used in many countries for literacy teaching.[14] Italy is one good example, and it can certainly contribute a great deal to this function in India too, particularly since trained literacy teachers are scarce. Television can also be used to train monitors and supervisors of the adult education centers. It must be emphasized that television would not be a substitute to the literacy study groups or the supervisors; it would supplement as a useful instrument to the monitor of the study group.

2.3.6 Improving the quality of rural life

India being a country of villages, making village-life more interesting and worthwhile should be an explicit objective of providing television. As an instrument of education and instruction, television has a major contribution to make in the village. But no less important is its role as an entertainment medium. It could take off some of the edge of glamor that the city has over the village, so that more of the better-educated young people would not want to leave the latter, where they could be very useful. Checking the increasing migration to the cities is not a small blessing. Nor is the beneficial but incidental decline in birth rate, which can be expected with the introduction of television in villages, as the people will then have something to do in the evenings. (There were newspaper reports that such an effect was indeed observed in Italy. The converse of the hypothesis needs little proof, after the well-known power black-out in the Eastern seaboard of the U.S. in 1965 and the sharp spurt in the number of babies born nine months hence!) The value of television in forging national integration has already been discussed. By being a window on the rest of the country (and the world), television could compensate for the physical isolation of most of the villages, which are not even accessible by motorable roads. If commercial advertising is also permitted on television, the implications are enormous in terms of facilitating national merchandising and consequently increased standard of living and economic growth due to greater production of consumer goods. With increased agricultural production, the purchasing power of the average villager is bound to go up, as the growing presence of transistor radios, watches, bicycles, etc. in the more productive villages indicate. Televison might also bring about a change in attitude towards innovating, so that people in the villages would buy implements or pumps for irrigation, or stock in village cooperatives, or even consumer goods rather than keep their money tied up in the form of gold jewelry. It was estimated a few years ago by the Reserve Bank of India that people's investment in gold (usually in the form of jewelry) in the country would run into several thousand millions of rupees (or a few billions of dollars). It would be very desirable if even a fraction of this amount is released for more productive uses. Likewise, a change of attitude towards education of girls might make people rethink about the practice of giving huge dowries at the time of giving away their daughters in marriage, which again has beneficial consequences for the individual as well as the nation's economy, (though perhaps not for the bridegroom!). Television might also provide a new focal point of social interaction in the village and this has obvious implications for tearing down caste barriers and even changing the traditional concept of the place of women in society. Watching community television regularly along with men would be a new and unprecedented pattern of activity for women, taking them out of their kitchen-and-kids orbit, and letting them be equally exposed to and informed about the outside world. Certainly, any of these fundamental social changes would take a long time to come about, but if they are triggered or accelerated by television, then the long-term benefits seem as valuable as school education or agricultural extension, in the short-run. Of course, much depends upon how it is used; one can also foresee a whole lot of undesirable and disruptive social effects, particularly in children. However, as Schramm and his colleagues point out in 'Television in the Lives of Our Children', on the basis of extensive research in the U.S., that television is at best, a contributory and not a primary cause in making children passive, withdrawn from life, or delinquent. To quote them, "it seems remarkable that if a child has security and love, interests, friendships and healthful activities in non-television hours, there is little chance that anything very bad is going to happen to him".

Since social change is intimately linked with economic development, the potential of television for modernizing attitudes, like the examples cited above, is as important as its ability to serve as an instrument of instruction. (The importance of communications and media growth is well essayed in Daniel Lerner's 'The Passing of Traditional Society', and the situation in the Middle East countries seems to have useful parallels for India.) The introduction of television on a large scale in the countryside would provide a fertile area for social research. Unfortunately, little work has been done on the aspect of social implications of television in the villages around Delhi.

CHAPTER 3

SATELLITE TELEVISION

3.1 Introduction

In 1964 the Electronics Committee, headed by the late Dr. Homi J. Bhabha, Chairman, Atomic Energy Commission, was established by the Indian Government and was charged with the responsibility of assessing the requirements of the electronics industry for fulfilling civilian and defense needs in the country and to draw up plans for achieving self-reliance rapidly in this important industry. Amont other things, the plans of various user departments of the Government, including AIR, were ascertained by this Committee for the preparation of its report. It was largely in this connection that the Atomic Energy Commission became interested in television. While AIR's plans for expansion were taken into account in the Committee's report, submitted to the Government early in 1966, it appeared to Dr. Vikram A. Sarabhai, who succeeded the late Dr. Bhabha, that in view of the potential of television to serve the needs of the country's development, a comprehensive examination should be undertaken to determine the most cost-effective way of providing nationwide television. The synchronous satellite seemed to be an attractive possibility. Interest in this direction was pursued further by the Department of Atomic Energy, as the 'peaceful uses of outer space', is, by statute, an 'allocated business' of it. Since then the initiative has been taken by the Indian National Committee for Space Research, of the Department of Atomic Energy, to make studies related to various facets of a possible satellite television system, which seemed to it economically superior to a terrestrial system.

3.2 Appropriateness of satellite television for India

1. The area over which a synchronous satellite can radiate signals is an order of magnitude higher than that of an airborne television system, and two orders higher compared to a terrestrial television station. Therefore, any country planning to use a satellite must be reasonably large in size - about a million square miles in area. For countries of smaller size, terrestrial or airborne systems would be more attractive in view of the shorter mileage of microwave links and the smaller number of planes required. India, with an area of 1.26 million square miles, is large enough, therefore, to justify a satellite system, as far as size of the country goes.

2. The total population (more than 530 million), and the average population density (421 per square mile), are also high, so that a large number of people derive the benefit of the system, and the satellite signals are not wasted anywhere (over large pockets of uninhabited areas which exist in most large countries).

3. In India, unlike most other areas of comparable size in the developing world, a single political entity is involved,

making it possible to use the satellite system exclusively without complicating it by having to share it with other neighboring countries. (However, there would still be some "spillover" of signal into adjacent countries.)

4. In contrast to the advanced countries where extensive terrestrial television systems exist, India has the 'advantage', as it were, of starting with a clean slate. As a result, the usual concern about the investment already sunk in the existing terrestrial systems, does not arise. This is one reason why a satellite is rather unattractive in the U.S. for entertainment televison. (Of course, there are also other technical problems like frequency. However, a case could be made to use a domestic satellite for linking all the educational television stations in the U.S. These stations cannot afford the higher cost of terrestrial hook-up through microwave links to provide a national network service, unlike the three big entertainment networks. It is also argued in some circles that a satellite system could be used to provide television more widely to under-privileged and far-flung areas like Alaska.)

5. As indicated in Chapter 4, economically, a satellite with direct broadcast capability is superior to a terrestrial microwave system for television coverage. The present value of the total costs, over a 20-year period, is about 22% more for a terrestrial system, compared to that of a direct broadcast system. This is a difference of about $60 million.

6. Besides money, a satellite system saves time enormously in introducing television, by being able to provide instantly nation-wide coverage. As mentioned in Chapter 1, it was estimated by AIR that a terrestrial network could cover only 25% of the population and 19% of the area of the country by 1981. Though, for both satellite and terrestrial systems, the production and distribution of television receivers is a limiting factor, the former permits scattering of the sets over a much wider area.

7. There are many urgent problems in the country requiring the use of television as already discussed in the previous chapter. Experience abroad and in India (e.g. the Delhi School Television Project and the Rural Television Project) has clearly demonstrated the potential of television in ameliorating many of these problems.[14,5,8]

8. As a result of the faster expansion of television, a satellite system could give an enormous boost to the electronics industry in the country, which is particularly beneficial to the economy in view of its high output-to-capital ratio and labor-intensive nature.

9. A nationwide satellite television system would generate tremendous employment opportunities for scientists, engineers, managers, technicians, programmers, artists, as well as for skilled and semi-skilled workers. A project of this magnitude and complexity could serve as a challenge and might prove exciting enough to help check the brain drain. It is felt that this argument would be less applicable to a

conventional system.

10. Last, but not the least, is the potential such a system could have in terms of the technological spinoff for India in the fields of space research, microwave electronics, materials technology, etc. if India undertakes the design and fabrication of not only the ground segment, but also the satellite itself, eventually.

3.3 Technical considerations

A detailed analysis of the technical considerations of satellite television and optimization of system parameters is beyond the scope of this paper. The subject has been studied by many people in considerable detail, and some of these are listed in the bibliography (References 35 through 40). What will be discussed here are some of the more important technical questions like the selection of frequency for the downlink transmission, which have implications for public policy. Also described, for the sake of completeness, are technical characteristics which appear optimal for India, based on studies made elsewhere. In this connection use would be made of the observations and conclusions contained in the paper submitted to the Working Group of the U.N. Committee on the Peaceful Uses of Outer Space on Direct Broadcast Satellites, by the U.S. Delegation, at its session held in New York in February 1969.[22] (U.N. Document No. A/AC.105/50)

3.3.1 Orbit selection

Because of the overwhelming advantage of the synchronous equatorial orbit in eliminating the need for tracking, and consequently simplifying and reducing the cost of the receiving installation, a sub-synchronous or inclined orbit is ruled out for India. Because of the large number of receivers involved, the dominant consideration in any satellite broadcast system is simplicity and low cost of the receiving installation. Another advantage of the synchronous orbit is the provision of continuous 24-hour service, except during solar eclipse periods.

3.3.2 Downlink frequency

The downlink frequency is perhaps the most important parameter in the whole system and has important technical, economic and political implications. There are no exclusive allocations made for broadcasting from satellites, except for several very narrow bands in the 1 to 10 GHz range. Because of sharing with terrestrial services, there are severe constraints on the power flux density that can be radiated from a satellite. According to CCIR recommendation, the power flux radiated from the satellite is not to exceed -152 $dBW/m^2/4$ KHz. Frequency allocation for space broadcasting is a problem of utmost importance and it is hoped that the next ITU World Radio Administrative Conference in late 1970 or early 1971, would take action to alleviate the present situation. Even if the main beam is concentrated over India, the sidelobes spilling over neighboring countries would create problems. So, special antenna systems need to be designed to reduce the power in the sidelobes. As Dr. Walter Morrow of Lincoln Laboratory points out, "though this may be technically feasible, unless a satisfactory agreement is reached with neighboring countries, spill-over of signal would create a political problem of the first order, and this may be regarded as the No. 1 problem with the satellite".[23] This becomes particularly important for India, considering that Pakistan is reportedly planning a UHF televison system. Because of the weaker signals of a satellite and different modulation, and the consequent need to equip each receiver with special front-end augmentation and dish antennas, there need be no fear that an Indian program would be received by a home-television receiver in a country like, say, Pakistan, against the wishes of that Government. The problem, however, is that the power flux density of the radiation spilling over adjacent countries could still be of a level high enough to cause interference to their terrestrial services. As pointed out in the U.N. document, mentioned earlier, the choice of the downlink frequency is influenced by "such factors as spacecraft complexity, atmospheric attenuation, cosmic noise, man-made noise, orbit and spectrum congestion and sophistication of Earth receiving installations".[22] Consideration of the crowded nature of the VHF (allocated but as yet mostly unused for television in India) and lower UHF bands, and the problems associated with deploying the size of satellite antennas (about 100 feet in diameter for higher VHF!) required to provide efficient coverage of country-sized areas, the very high level of cosmic background noise and man-made noise, rule out VHF and the low UHF bands for broadcasting from satellites. Frequencies in the 12 GHz band (11.7 to 12.7 is now allocated to broadcasting, fixed and mobile services) seem to be a possibility because they are virtually vacant and permit more efficient use of the synchronous orbit, with closer spacing of satellites. However, this band appears very unattractive for India for the foreseeable future for the following reasons. At these frequencies the cost of receiving equipment is much higher; very little experience exists in India - or even abroad; propagation through the atmosphere is poor, particularly due to attenuation and scattering by rainwater, which can be a serious problem for India, with many areas having an annual average rainfall of about 100 inches; there is a lack of efficient power generating devices; and lastly, this band is used by terrestrial systems. The problem os sharing with terrestrial services and consequent restriction on radiated power in the 1 to 10 GHz band has already been mentioned. Therefore, there is hardly any choice left, but to consider the higher UHF band. This band (around 800 to 900 MHz) appears attractive, not only for India, but for other countries as well, since it is relatively unused, the technology involved is on hand, both in terms of the size of the spacecraft antenna (about 32 feet in diameter for 860 MHz), and the cost and complexity of the receiving installations. The cost of the front-end augmentation is currently estimated around $150, for production in quantities of about a million units.

3.3.3 Space-window allocation

Allocation of space-windows for positioning synchronous satellites is an issue, next in importance only to the question of frequency allocation. At synchronous altitude, for a given location in space, a satellite pre-empts the particular frequency band it uses, for all the countries which fall within its area of coverage. So space-windows, like frequency spectrum, constitute a precious international resource and its use calls for international regulation. The problem is quite serious in view of the much larger bands required for FM television. Since countries like India would need more than one video channel for an operational system, the problem is all the more compounded.

3.3.4 Modulation

Frequency modulation (FM) is far more advantageous than amplitude modulation (AM) for broadcast from space because the former provides a saving in satellite power between 1 and 2 orders of magnitude over the latter. The penalty for FM is that it requires greater bandwidth, besides modulation conversion at the receiving end if a conventional set is used.

3.3.5 Receivers

The characteristics of the receiving installations greatly affect the size, complexity and, consequently, the cost of the satellite and technical feasibility of providing a particular grade of service. This is because of the possible tradeoff between satellite power and size, and receiver sensitivity. A downlink frequency of 860 MHz and a 'community grade of service' appears optimal for India. This grade of service could provide a quality of picture about equivalent to that of 'primary grade', although the signal strengh may be considerably lower. This is made possible essentially by the addition of a pre-amplifier and the larger antenna of the community receiver. The receiver uses an antenna-mounted front-end consisting of a pre-amplifier and a converter to change the modulation from FM to AM and the frequency from UHF to VHF, so as to be compatible with a conventional home-receiver. Intuitively, it appears that when one is starting from scratch, as in India, it might be cheaper to design and produce a new television receiver to receive satellite signals directly for FM and UHF than to provide for conversion from FM to AM and from UHF to VHF, by means of an additional unit. Expert opinion at MIT's Lincoln Laboratory confirms that it is possible and desirable to design such a new receiver less expensively than to provide conversion for a conventional set.[23] Such sets would, of course, not be compatible with terrestrial VHF, AM transmissions. But that is no drawback. Since a very large number of both types of sets would be needed, as will be seen in the next chapter, two different designs could be produced: one for direct reception from a satellite, and the other, a conventional set.

3.3.6 Satellite power and channel capacity

As the required area of coverage becomes smaller, the size of the spacecraft antenna increases, and so does its gain, as a result of which, lower satellite power is enough to provide a given power density or signal strength. Usually the satellite power limitation is a more critical one and is reached sooner than the limitation on size of antenna. A beam of about 3^o by 3^o should provide adequate coverage of India from a satellite located over the 78^o E longitude. For this illumination, the half-power beamwidth contour does not fully circumscribe the country, but ensures that spill-over into Pakistan is minimal, and at the same time covers almost the whole country, except the states of Kashmir and Assam. Of course, the signal strength does not drop abruptly to zero at the borders of the half-power beamwidth (-3db) countour. As the name of the contour implies, the signal strength is down by only 3 db at the contour, which is why coordination with neighboring countries is necessary. An operational satellite for India would most probably have to have multi-channel capacity. Each video channel could have more than one audio channel associated with it because of the language problem in India; audio channels require a very small additional bandwidth on the satellite. However, the facility of audio channel selection would have to be provided in the receivers, which would increase their cost, but not significantly. (Estimated to be less than $5).[23] Though more video channels would mean more power on the satellite, for community grade of service, it has been calculated that 2 or 3 video channels could be provided without much difficulty.[22]

3.3.7 Characteristics of a satellite system to meet Indian needs

The characteristics of a satellite which seems appropriate for India are given on the next page. This, incidentally, is the kind of capability that is being planned for NASA's ATS-F satellite. The technology involved is considered feasible by NASA, though certain elements like 80-watt solid-state transmitters in the 800 MHz range, and antenna structures of 9 to 10 meter diameter, which are to be deployed in space with a high pointing accuracy (0.2°) need to be flight-tested.[22]

Characteristics of a satellite system to meet Indian needs

Useful satellite weight	750-900 Kg.
Cost of satellite	$15 million
Cost of launching (Titan III C class)	$12-16 million
Projected date of availability	1975
Cost of receiver "augmentation" equipment required (For production quantities of one million units)	$150
R.F. Noise bandwidth	20 MHz per channel
Carrier-to-noise ration before demodulation (exceeded for 99% of the time)	17 db
Antenna beamwidth at 3 db points	2.9°
Antenna gain at edge of zone, relative to an isotropic source	33 dB
Approximate diameter of antenna	10 meters
Satellite power	19 dBW per channel (or 80 watts)
Primary power requirement	900 watts
Receiver characteristics:	

Antenna type	3-meter dish
Antenna gain	25 dB
Pre-amplifier noise figure	4 dB
Line loss	0

(Source: Report of the Working Group on Direct Broadcast Satellites, of the U.N. Committee on the Peaceful Uses of Outer Space.[24])

3.4 Inputs required for satellite television

Having discussed the potential of television and the technical characteristics of what is considered a feasible direct broadcast satellite, attention is now turned to an examination of the inputs required if India decides to go in for satellite television. Since the economics of alternative systems is discussed in the next chapter, the technical base, the personnel requirements and the problem of programming for heterogeneous needs will be examined here.

3.4.1 Technical base

To begin with the satellite, India does not have the capability at present to design and build a satellite, to mention nothing of its launching. Therefore, international arrangements will have to be made both to procure the satellite and to get it launched. The problems related to this are considered in detail in Section 5.7. Indian leaders and officials have repeatedly emphasized that any plan for the expansion of television in India should be undertaken as an indigenous effort as far as possible. This is not only laudable, but essential to conserve foreign exchange, which is extremely scarce; to give a fillip to the infant but fast-growing electronics industry; and to provide a challenging opportunity to Indian scientists, engineers and technicians to contribute to an important national effort.

In view of the large number of television receivers required, and the fact that they represent about 73% of the total investment,[1] the television receiver is easily the most critical element in influencing the economics of the whole effort. As will be clear from Section 5.3, the technical base is not too promising as far as receivers are concerned. It is likely that the demand would outstrip supply before long, and the set using a tube-design cannot be used in most villages without a separate power supply unit. Knowhow for direct receivers will have to be obtained from the U.S. which will perhaps require some kind of a commercial collaboration. Television transmitters and receiver picture tubes are to be made at Bharat Electronics Ltd. (BEL), Bangalore, a public sector corporation under the Ministry of Defense, making a host of electronic components and equipment. Though collaboration agreements have been concluded, it is not known if production has commenced. It is also not known if the television transmitters to be produced at BEL are of the high power (50 KW ERP) required by AIR. However, since BEL is a well-established company with considerable expertise, production of these items in adequate numbers should not be difficult by the time a satellite television project gets started.

Turning to satellite Earth stations, India seems to have considerable experience in their assembly and operation. A satellite Earth station with a 14-meter dish has been in operation at Ahmedabad, under the control of the Department of Atomic Energy, since July 1967. It was established with assistance from the U.N. Development Program, as a facility for research and training in satellite communications.[25] Though Indian engineers have participated in the planning and erection of this facility, most of the hardware was supplied by Nippon Electric Company of Japan. The Department of Atomic Energy has also been given the systems engineering responsibility for building the first satellite Earth station for commercial communication in India, at Arvi, near Poona, which is to have a 97-foot, fully steerable antenna. However, much of the hardware is being imported from RCA, Canada, and Blaw Knox, of the U.S. This station is expected to be ready by October 1969, to work with the Indian Ocean satellite of INTELSAT, to be launched soon. No production capability exists in India, as of now, to build the critical elements of satellite Earth stations: microwave power amplifiers, low noise receivers, and the antennas. However, the capability could be developed considering the equally sophisticated work that is being done by the Tata Institute of Fundamental Research (a premier laboratory of the Atomic Energy Commission) in setting up the giant radio-telescope facility at Ootacamund, in the South, to cite as an example. Efforts could be geared up to build the requisite satellite Earth stations, particularly the receive-only stations in time for a national satellite television project.

Very little studio equipment is currently made in India and it is doubtful if it could be produced in the requisite quantity and quality to be ready even for a limited project in the early seventies. Studio equipment will therefore have to be mostly imported. No video-tape recorders are made, and the audio ones made are not of studio quality. A television camera has recently been developed at the Central Electronics Engineering Research Institute (CEERI), Pilani, and it is expected that the first commercial one would be in the market by the end of this year. Microwave and coaxial linkage is limited both by mileage and by capacity. The additional linkage planned for the Fourth Plan is complete interconnection of all the state capitals and major cities (about 8,500 km. of coaxial and an equal length of microwave), primarily to meet telephone and telegraph requirements and there is hardly any additional capacity for television.[26] This is not too critical for a hybrid satellite system, which has been shown in the next chapter to be the optimal one for India. Moreover, in view of the good rail and air transportation facilities between the cities, video tape exchange between major cities is easily done.

The electronic component industry is rapidly growing, largely due to the increasing sales of radio-receivers - both tube and transistor. Import of radio receivers has been completely banned in India for many years now and radios over a wide range of prices, capability, and quality, are made in the country. Both tubes and transistors are produced, though not power transistors. Finally, rural electrification has lagged considerably in the past, but is now receiving greater attention and support from the Government. Though electric power is available to all communities with a population of more than 10,000, and in a high proportion of towns smaller than 10,000, only about 58,000 of the 567,000 villages have power.[1] Even though the Government is giving considerable importance to rural electrification, the magnitude of the task is such that it can take a few decades before all - or even most of - the villages are electrified. An accelerated program is under way and it is hoped that by the end of next year 100,000 villages would have power. Since the expansion of television would soon outstrip rural electrification, particularly if a satellite is used, it is essential to start the manufacture of solid-state receivers, as well as inexpensive power-supply units on a large scale.

The technical base is, therefore, on the whole somewhat mixed, though the potential exists to build a strong infrastructure for a viable satellite television system, provided there is a will to go ahead and a willingness to learn from past mistakes. Islands of excellence are not enough; what is needed is the diffusion of competence and harnessing of expertise for the solution of practical tasks.

3.4.2 Personnel base

There are four major categories of personnel required for a national satellite television project: 1. managerial, 2. program, 3. scientific and technical, and 4. end-use monitors (i.e. village level workers, school field staff, teleclub supervisors, etc.). In India the first category is perhaps the most important and scarcest. There are many trained professional manageg ers in private industry, but very few in the Government. An enterprise like this requires a corps of competent professional managers and cannot run efficiently with just the civil servants already in Government service. The new Institutes of Management and other business schools in the country may alleviate this problem - if the Government decides to, and is able to compete with the private industry in attracting and retaining the alumni from these institutions in large numbers. The importance of managerial personnel cannot be overemphasized, since without strength in organization neither technology nor capital can yield much results.

Talented program personnel are equally scarce and critical for the expansion of television. This category comprises essentially the creative aspect of program production. AIR has so far sent about 20 program personnel and 30 engineers abroad for training in television (for the one, small 2-hour-a-day operation in Delhi!), though not all of them currently work with television. AIR estimated that, to staff 56 stations adequately (41 of them for limited one-studio production) would require 2,500 to 3,000 program personnel and 3,500 to 4,000 engineers.[27] There is no independent television training school, while there are a few schools for films, notably the Film Institute at Poona, established by the Government. The Staff Training School of AIR in Delhi has in recent years been assigned the additional task of training for television. It uses the facilities of the Delhi station and is expected to have some of its own in the future. Training is, therefore, essentially an on-the-job experience at the Delhi station. In view of the language problem, stations in each state will have to train its own program staff. In addition, translators would be required having a facility with more than one regional language, besides Hindi and English. In the short run the existing talent available at the three well-developed film centers could be tapped. This is quite substantial since India has a sizeable film industry, ranking third in the production of feature films (Japan and HongKong taking the top two places, in that order). However, it would be essential to start schools for training in all aspects of television, very soon. The Film Institute at Poona could perhaps provide training in television too, in the interim.

Scientific and technical personnel are needed for a host of tasks: design, manufacturing, operation, maintenance, and in a wide range of areas including satellite Earth stations, television transmitters, studios, microwave links, and, of course, receivers. It is difficult to estimate the personnel requirements precisely, as they vary widely depending upon assumptions made regarding the assignment of work. It is clear that these numbers run into the thousands. However, this is not a critical problem considering that there are more than

40,000 unemployed engineers in the country. A sizeable fraction of this number could perhaps be absorbed for this project. At the higher levels of skill also, the large number of qualified Indian engineers and scientists abroad, notably in the U.S., is one potential source of supply and a project of this nature may attract even a fraction of them back to India, and incidentally help reverse the brain drain. It is difficult to make any meaningful estimates in this regard.

The fourth category of personnel is also important though not difficult or time-consuming to train. People need to be trained in the use of this new medium. Teachers need to be trained in the use of television for teaching, a large field staff is required for maintaining liaison between the television stations and the schools. Likewise, a lot of people in the other user ministries like agriculture, family planning, etc., need to be trained in using television. Supervisors and monitors would be needed to run the teleclubs and follow up the telecasts with other activities and inputs. The village level workers are a good nucleus to start with for agricultural extension, but there are only 40,000 of them.

The conclusion, therefore, is that appropriate steps have to be taken immediately if the enormous personnel requirements are to be met.

3.5 Programming for a satellite television system

The problems of planning, developing an infrastructure and manning the effort, discussed so far, relate really to the expansion of television and most of these problems have to be tackled irrespective of the decision to use a satellite. In terms of investment, number of people involved and planning and preparation required, the space segment is relatively a very minor part of the whole system, though because of its somewhat dramatic character it may appear more important and receive more attention - particularly in the public eye. Apart from the question of availability and access to a satellite (which is discussed in Section 5.7), the key issue or problem unique to a satellite system arising out of its ability to deliver signals over vast areas, is the question of whether the centralized character of a satellite can be meshed with the diverse needs and audiences in an extremely heterogeneous country like India. There is no doubt that in this whole process, the pace of progress in technology has far outstripped that in the field of social sciences and in understanding human behavior and motivation necessary for effective programming. It is therefore necessary in this connection to understand the nature and extent of heterogeneity in the country, though the matter has already been alluded to in Section 2.3.1. It is safe to say that no other country in the world is as diverse as India. The most important element of diversity, particularly for mass media of communication, is language. There are 15 official languages, 35 unofficial languages, each spoken by more than 100,000 people, and in all over 800 languages and dialects in the country. Language has become a very touchy issue in recent years, and most states use the regional language to the fullest extent possible. The psychological identification to the language and culture of one's own region is quite intense and every effort is made to preserve the differences with great sensitivity. There are 17 states and 13 Union Territories, including Delhi. Mobility between the states for purposes of employment is limited except for jobs in the Central Government and the larger private sector corporations, partly because of the language. Since education, like language, is a 'state subject' under the Constitution (i.e. under the exclusive jurisdiction of each State Government), the educational systems-and of course the language of instruction-vary from state to state, despite efforts of the Central Government to achieve some uniformity. Each state is free to evolve its own curricula, set its own syllabi and prescribe its own textbooks. This adds greatly to the heterogeneity problem, making it virtually impossible to use the same program from the satellite for more than one state, even where the language is the same, as far as school programs are concerned.

There are more than 80 different agricultural regions based on crops, soil, climatic conditions, etc., with different needs for information. Since the same crop is grown in more than one state and more than one crop is grown in each state, language and crop differences jointly enter into consideration for disseminating agricultural information. Cultural and ethnic differences are also reflected in appearance and attire of the people shown on television, making it difficult for the audience to identify with the communicators on television. The one redeeming feature of uniformity, amidst all this heterogeneity, is that the whole country is on the same time standard. (The Indian Standard Time, being the time on the 82° E longitude.)

Despite this situation, Indian leaders and officials, as well as outside experts who visited India, like the Unesco Expert Mission, and Professors Schramm and Nelson, conclude that a satellite system can be used in India to meet the demands of such a heterogeneous audience, without losing most of the value for nationwide program distribution.[28,1] It has been indicated in the Schramm-Nelson report that with ingenuity and proper scheduling, using a satellite with one video channel and two associated audio channels, in each of four languages, it would be possible to provide 40 fifteen-minute periods of televised instruction per week, during school hours, to meet various local needs. Similarly, a substantial amount of programming to meet a variety of other requirements could be provided in the remaining hours late in the afternoons and in the evenings. Some sample schedules have been drawn up by Schramm and Nelson indicating this (pp. 128-129). They conclude, therefore, that it is possible to provide a substantial amount of programming to meet both local as well as national needs, in spite of the heterogeneity prevailing in the country. Multiple audio-channels, repetition of programs in different languages, commentaries, dubbing, subtitling, simultaneous translation on radio, are all techniques which can and should be tried to cope with the language diversity. However, as they also observe, the value of satellite broadcasting is undoubtedly less in India compared to other homogeneous countries because of the relatively inefficient use arising out of the heterogeneity in the former. Even if great ingenuity is exercised both in the design of the space segment and in programming, the inescapable conclusion with regard to tackling the problem of diversity is that terrestrial television stations in each state are a must and the facility of transmitting programs to the satellite will have to be provided in at least five regional centers (North, South, East, West and Central), preferably close to the major centers of programming (and film) talent in each of these areas. Regional television stations are necessary because it is just not possible for a producer in Delhi to do an instructional program that would make any sense to a viewer in say, Kerala, or for that matter in nearby Punjab. Secondly, in the absence of local stations, the sets would be used much less if all the areas are to be served by programs from the satellite.

Major film centers exist at Bombay, Madras, Calcutta and Hyderabad. These four, plus Delhi, from where many programs of national interest will originate, being the capital, seem to be the ideal locations for the satellite Earth stations. The existing Ahmedabad station could serve the production center at Bombay, if a microwave link is established between the two cities, having the necessary capacity for one or more channels of television. A second important conclusion is that in view of the complexity of a satellite television project, it seems essential to proceed in a gradual, step-by-step fashion, particularly to see how the programming works out for the heterogeneous needs. The next section describes briefly, such a limited effort: the proposed joint India-NASA instructional television experiment.

In view of the problem of heterogeneity and the inevitable need to have local stations and programming, many people have seriously questioned the validity of a satellite television system for India. However, it would seem unfair to dismiss the satellite alternative altogether on this ground without giving it a try, since its potential is indeed very attractive, as already discussed. This dichotomy, therefore, lends support to the idea of an experiment to get first-hand experience on a project like this, involving complex and not fully-understood problems and benefits. It is hoped that the joint experiment with NASA would throw considerable light on this rather fundamental question.

3.6 The proposed joint satellite television experiment with NASA

Based on discussions between the Indian National Committee for Space Research and NASA, a proposal for a satellite instructional television experiment has been prepared and a formal agreement is expected to be concluded between the two Governments. The proposal to be described here is a tentative outline and the details are subject to modification.[7] The effort is described as a pilot project since the complexity, unfamiliarity and magnitude of the technology and the programming involved necessitates gradual and phased growth. Also, the satellite to be provided by NASA is for the specific experiment and not for an operational system.

In essence, the experiment envisages the use of the ATS-F satellite for approximately one year, to broadcast Indian developed instructional program material to community receivers in India. Technically, the overlap of Indian and U.S. interests which makes this project mutually worthwhile is the feature of direct broadcast of television signals from a synchronous satellite. NASA's interest lies in developing and testing the direct broadcast technology which is considered feasible but remains to be demonstrated. The two scientific missions of particular interest to NASA in this experiment are deployment in space of large antenna structures, and its accurate pointing. Studies already made show that direct broadcasting is economically the most attractive alternative for India, and, therefore, unless a satellite has this capability it would not be of much interest to her.[1,7]

The satellite is expected to be launched in the 1972-1973 time period and made available for Indian use for about a year, after completing certain other scientific missions over the U.S., within a few months after launch. The technical characteristics of the satellite have already been described in Section 3.3.7. The cost is estimated to be about $30 million for the satellite in orbit and would be borne by NASA. The space segment is to be entirely the responsibility of NASA, while the ground segment responsibility would be that of India.

For the Indian experiment a downlink frequency of 860 MHz with an R.F. bandwidth of 30 MHZ, which is adequate for one video and two associated audio channels, is planned.

The set-up for the ground segment envisages 5,000 television sets in all. Transmission to the satellite would be from the Earth station located at Ahmedabad, and received by three receive-only and rebroadcast stations, each catering to about 1,000 conventional sets, and by 2,000 augmented receivers, in four areas having clusters of 500 sets each. The operation is, therefore, a 'hybrid' of direct and rebroadcast systems. The receivers would be scattered in about 8 different states and the language problem would be tackled essentially by having different regions use the satellite on a time-shared basis, and by using the dual audio-channel capability. The variety in environment for the 5,000 receivers and in subjects on which programs would be telecast, is hoped to provide a wealth of data and experience on all facets of operation of the system including receiver maintenance and programming techniques to enable systematic planning of an ongoing operational system. The total capital costs of the ground segment, to be borne by India, are estimated at $6.64 million for this experiment. Excluding the investment in existing facilities, the additional capital outlay is about $4.2 million, with perhaps 25 to 30% in foreign exchange.[7]

CHAPTER 4

SYSTEMS ANALYSIS OF ALTERNATIVE STRATEGIES

4.1 Definition of problem:

The objective of this analysis is to determine the particular system, among alternatives, which would be most appropriate and cost/effective for providing nationwide coverage in India. Since the objective of providing television coverage is taken as a requirement to be met, the question, 'does India require television and what is its relative effectiveness vis-a-vis other media', is not relevant here for this particular analysis. Quite a few studies have already been made in India and elsewhere comparing the costs of various sytems, and this analysis draws on these and on the Schramm-Nelson report in particular, as a starting point for the cost analysis.

Before proceeding further, it is necessary to explain what exactly is meant by providing nationwide television coverage. Firstly, the analysis is concerned only with Government-owned community receivers and not privately owned home-receivers. The community sets would be installed at urban and village tele-clubs, located in schools, factories, community centers, etc. for public viewing. Obviously, in the cities and the more affluent villages people who can afford to buy their own sets would do so and eventually their number would be quite large - if the unsatisfied demand for home-receivers in Delhi is any indication of this potential.

Secondly, what is aimed at is 80 to 85% - and not 100% - coverage of the present population (as per the last official census taken in 1961), over the next 20 years. Though the figure is somewhat arbitrary, it is reasonable since 85% is quite a substantial fraction and not too far below "nationwide" coverage. Also, the time and cost of reaching the remaining 15% is quite out of proportion with the cost of reaching 85% of the population. This is in the nature of things and virtually no country has been able to provide 100% population coverage. In the case of a satellite system, though the signal reaches the whole country, the service exists only if a television receiver is provided at any given location. If receivers are provided on a decision rule based on size of village, clearly a point will be reached when an additional receiver serves a hamlet with a population of just 50 or some such small figure. The marginal utility of extending coverage therefore decreases rather sharply as one approaches 100% coverage. In the case of a terrestrial system, in addition to the cost of installing a receiver, one needs to reckon the cost of extending the signal to the remote location. The latter additions of television stations, translator stations and relays would yield smaller and smaller increments to the population covered.

It is assumed in general that if one receiver is installed in a village it could be considered that television is made available to the entire population of that village. This assumption appears to be quite valid, based on the experience with the villages around Delhi. Since different groups concentrate on different kinds of programs, a single receiver can in fact serve an average village in India. For example, children can watch school programs in the morning, women can watch health and hygiene or family planning programs late in the afternoon and men can watch agricultural or other social education or literacy programs later in the evenings, when general news, cultural and entertainment programs can also be scheduled for everybody to watch. Since there would be only one channel to begin with, the problem of conflict between multiple channels and viewing groups does not arise, making scheduling relatively simple.

To calculate the number of receivers required one needs to know how they are to be distributed and allocated. The approach taken by the Schramm-Nelson report seems reasonable and has been adopted here. For urban areas, it appears adequate to provide one set for every 2,000 people. 80% of the population is in the rural areas and the other 20% live in cities and towns. So, if a national system covers 80% of the villages and all the cities, the total population coverage would be 84% (64 plus 20). Since there are 567,000 villages in all, 80% coverage of them would require 454,000 receivers. The cities would require an additional 44,000 sets (based on 1961 census figures for urban population, divided by 2,000). The total number of receivers required therefore is 498,000. It must be noted that this 80% of the villages would have more than 80% of the rural population, since the 20% of villages left out would be the smaller ones. So these sets would, in reality be yielding a total population coverage of perhaps 90% or 95%.

4.2 Criteria for evaluation

Having defined the problem, it is necessary to spell out the criteria that would be used to evaluate the alternatives. The following criteria seem relevant in this connection, some of which are quantitative, and some qualitative.

1. Cost: By cost, what is meant here is total cost which includes capital, replacement, operating and maintenance costs. Though this is stated as the first criterion, it is by no means the most important one. In view of the availability of data on costs, the analysis of this aspect is naturally in greater detail.

2. Reliability: Vulnerability of the system to total failure due to failure in any single sub-system is obviously something to protect against and hence becomes an important criterion.

3. Initial coverage of population: Television is to be used primarily for instructional/educational purposes, to help solve urgent problems facing the nation, like population growth, agricultural production, meeting the shortage of trained teachers, etc. Therefore, a system which gives greater population coverage in the first 5 or 10 years is more valuable than one which provides the coverage later.

4. Flexibility: Since an untried and undemonstrated technology is involved (i.e. direct broadcasting from a

satellite) for two of the alternatives, it becomes desirable to have flexibility to change mid-stream from one strategy to another or drop a strategy altogether, with minimum penalty for doing so. It is not only difficult, but also not meaningful, perhaps, to try to quantitatively "weigh" these four criteria in evaluating the alternative strategies. The analysis would, however, examine how the alternatives fare, measured by each of these yardsticks.

4.3 Constraints

As will be seen from the analysis, the four strategies vary considerably in meeting the criteria defined above. In addition to these criteria there are certain other requirements which have to be met equally by any system to be used in India. Hence these may be regarded as built-in constraints, arising as a result of the unique Indian requirements, and are described below.

1. National service: The first requirement is that any system should have a national hook-up facility, i.e., the capability of providing, whenever required, a common single program for the entire country. This is considered essential from the point of view of national integration and also provides the Central Government with a capability to communicate to the whole nation simultaneously, on television. The current interest of many people in supporting television stems considerably out of a recognition of the medium's potential to serve as an integrating force.

2. Local programming: As discussed earlier, in view of the heterogeneity of audiences and needs, the facility to produce programs locally in each of the 17 states becomes a must for all the alternatives.

3. Rural coverage: Again, for reasons discussed already, a third requirement is that any system should cover not only the urban centers but also the villages equally well. The four alternative strategies, to be described in the next section are designed to meet the three requirements stated above, which incidentally facilitates making a fair comparison between the alternatives. It would be erroneous, however, to infer that they have been distorted in order to make a comparison on a common basis. They are in fact very realistic and if any one of the alternatives is implemented, the details are not likely to be very different from what is described here.

4.4 Description of the four alternative strategies

4.4.1 Terrestrial system

This system is the familiar and common method of providing television coverage in most countries. It makes no use of a satellite and involves no untried technology. It expands ground-based television in gradual steps with the addition of new television stations and translator stations, with conventional microwave interconnection to provide a national service. Since the propagation of television signals is by line of sight, the area of coverage of a station depends upon the height of the antenna mast, the transmitter power, and the frequency used for transmission. Nationwide coverage is therefore made possible by having stations, main as well as translator, all over the country, and linked by microwave interconnection.

As described in the Schramm-Nelson report, under this strategy, in the first five years the Delhi station would be upgraded and new stations with major studio facilities would be built in the five large cities: Bombay, Calcutta, Madras, Kanpur, and Hyderabad. In the second five years another 11 stations would be built, so that all the state capitals are included. Finally, at the end of 20 years, there would be complete nationwide coverage by means of 100 primary stations and 100 translator stations which would carry the signals beyond the Class A coverage area. (The quality of the signal in the Class A region is Grade 1.) These transmitters would have a coverage area of 7,850 square miles (or a 50-mile radius), assuming 50 KW effective radiated power, and 500-foot antenna masts. Taller masts would increase the coverage and change the economics of the system, but it is learned from AIR that they are not currently considered feasible in India, largely due to engineering difficulties. It has been estimated that about 14,000 miles of microwave interconnection would be required to link all these stations. To meet the language, cultural and educational requirements of the various parts of the country, it seems adequate to have studio and program production facilities attached to the transmitting stations in each of the 17 states. The quantitative details of the expansion over a 20-year period, reflecting not only the technical feasibility but also the tentative plans of Government organizations like AIR, are given in the Schramm-Nelson report (pp. 129-193) and they are not repeated here.

4.4.2 Direct broadcast system

As the name implies, for this alternative there would be no ground television stations at all. All signals come from a synchronous satellite and would be received on sets with special 10-foot parabolic antennas and other front-end augmentation in the form of a pre-amplifier-converter for conversion from FM to AM and for frequency translation from UHF to VHF, as described in Chapter 3. In international technical parlance "direct broadcast" means broadcasting from space directly to conventional home-receivers. This technology is considered to be more than a decade away (around 1985).[22] The word "direct broadcast" is used a little loosely here to include reception by augmented rather than conventional sets. The broadcast can be considered "direct" since a rebroadcast station is not involved, as in the case of a distribution satellite, which is described as the next alternative. For the direct broadcast system programs would be produced at 17 production centers (16 in addition to the existing one at Delhi), representing the chief languages, cultures and political areas, and transmitted to the satellite from any one of five Earth stations, attached to five major production centers. Earth stations would be located at the chief program sources such as Delhi, where the Central Government is located, Bombay, Calcutta and Madras, where there are also large concentrations of motion picture talent. One earth station already exists at Ahmedabad. (A sixth station at Hyderabad could also be considered to serve conveniently the central region of the country, since the other stations take care of the regions in the North, South, West and East.) Video-tape copies of programs would be sent from the other production centers to the five Earth stations for transmission to the satellite. It is assumed that the first satellite would be provided by NASA for a one-year period, for the proposed pilot project, at the conclusion of which the first operational one would have to be bought. Based on expert opinion, it is also assumed that the first operational satellite would have a five-year life and the second one ten years. It should be noted that this system provides signals of comparable quality to terrestrial broadcast.

4.4.3 Rebroadcast system

Here, a 'distribution' satellite (which has lower power compared to a direct broadcast satellite) replaces the microwave interconnection linking all the ground-based television stations. Since there would be no microwave links at all, a much larger number of ground-based stations would be required to provide nationwide coverage, even though many of them could be small. Each of the ground transmitters would need to be provided with the facility of receiving signals from the satellite. This is known as a 'receive-only' facility (since no transmission is made to the satellite from these stations), and typically makes use of a 25-foot dish for this purpose. This system avoids the expensive front-end augmentation for the receivers (which is required for the previous alternative), as the signals received from the satellite are fed to a conventional VHF transmitter for rebroadcast to ordinary receivers in its local area. This alternative also bypasses the problem of frequency of telecasting from space in view of the lower power levels radiated. Theoretically, for both the direct broadcast and the rebroadcast systems, a single program source would do, to transmit all programs to the satellite. However, as explained earlier, to meet the constraint of having to provide local programming, 17 production centers and five Earth stations are specified for both these as well as the next alternative. It is important to note that with this system the television stations can be used even before a satellite becomes available, by using video-tapes for program exchange to the stations without production facilities, though it would be an expensive process in view of the large number of stations involved.

4.4.4 Hybrid system

This system combines elements of direct and rebroadcast systems to get the best of both worlds, as it were, depending upon the particular requirements of a given area: high or low receiver density. It provides for a limited number of ground rebroadcast stations in the cities and direct broadcast from a satellite to augmented receivers in the more remote villages and smaller towns. Here, 24 gound based stations are specified (17 state capitals and seven other large cities). Once again, there would be 17 production centers and five Earth stations to meet the requirements of local programming.

4.5 Cost analysis

Table 1 gives the basic estimates on which the cost calculations are based, and relate to the Indian situation. These are in most cases higher than costs in the West, but more relevant, since these are the costs that would actually be incurred by India if she were to implement any of the alternatives. The crux of the quantitative analysis here is the comparison of costs for the four systems. So, it is very important to ensure that the comparison made is a fair one. The signal received should therefore be of comparable quality for all the four alternatives. The costs are based on technical characteristics which meet this requirement. Also a fair comparison is ensured by seeing that all the strategies equally meet the constraints specified.

Since the "benefit" of all the alternatives is the same, i.e., providing 84% population coverage, a comparative cost/benefit analysis is reduced to finding the least-cost solution. Calculating the economic benefits or providing television is not relevant here, since that would be required if the problem were to decide whether the Government should allocate its resources for television or for some other enterprise. But that is not the problem defined for this analysis, and has been qualitatively discussed in Chapter 2.

TABLE 1

BASIC COST ESTIMATES*

(Based on Indian experience or estimates, except where noted otherwise)

All figures in dollars

1.	Standard TV receivers, including antenna and tax	240
2.	Front-end augmentation for receivers	150 (U.S.)
3.	Power supply units for villages (assuming a bicycle generator, or the average of an animal driven ($70.00) and gasoline driven ones ($120.00)	100 (U.S.)
4.	Microwave links (cost per mile)	6,667
5.	TV stations, large (with 2 to 4 studios; includes land, building, transmitter and other equipment)	2 M
6.	TV stations, small (with limited production facilities)	1 M
7.	Low-power translator stations	150,000 (U.S.)
8.	~~Satellite receive-only station~~	~~100,000~~
9.	Satellite earth station (including land and building)	1 M
10.	Maintenance:	
	Studio and transmitter equipment	10% of capital costs p.a.
	Buildings	2% do
	TV receivers	10% do
	Microwave links	5% do
11.	Replacement:	
	Village TV sets	5 years
	Urban sets	10 years
	Studio and transmitter equipment	20 years
	Satellite: 5 years for the first operational one and 10 for the next.	
12.	Operating costs:	
	Major TV stations	0.5 M
	Supplementary stations	0.25-0.35 M
	Small stations (limited production)	0.175-0.225 M

*Source: Schramm-Nelson report

The question that arises now in finding the least-cost solution is, what cost should one take? Since the technology, life-times of equipment and sub-systems, requirements of operation and maintenance, are all different for the four systems, it is essential that total costs are taken, which include not only capital, but also replacement, operating and maintenance costs. For example, a satellite needs replacement after 5 years, but involves lower operating and maintenance costs for the whole system, since there are no microwave links and there are fewer ground television stations; whereas ground-based stations have a 20-year lifetime but involve higher operating and maintenance costs.

Since the phasing and amounts of investments required are different for the four alternatives, over the 20-year period under consideration, it is important to compare the present value of the total costs, rather than the undiscounted total costs. This is a refinement of this analysis over other previous ones. To begin with, an interest rate of 6% was taken to compute the present value of the total costs. Though this is an arbitrary figure, it appears reasonable considering that resources in a developing country like India are very scarce. Therefore, in India, 6%, or an even higher rate, would reflect the true costs for the Government in a more realistic way. (Generally, it is more common to use a lower imputed rate of interest like 2% or 4% for Government investments.)

Table 2 shows the total cost and the present value of the total costs for the four alternatives. The undiscounted total cost figures are taken from the Schramm-Nelson report. For purposes of computing the present value it is assumed that within any five-year period the investment made per year is an average of the amount for the five-year period. Such an assumption becomes necessary because it is not possible to make any realistic estimate of the exact amount that would be invested for each of the next 20 years. If, however, these amounts are known, it would be more accurate to use those figures in computing the present value of the total costs. The amount that would be invested in each of the four five-year periods, as a percentage of the total investment for each of the alternatives, is indicated in Table 3.

It is interesting but not surprising that the ranking of the four systems in terms of cost, changes when the present value is used, compared to what it is with undiscounted total cost. As may be seen from Table 2, when undiscounted total cost is taken, the least-cost ranking of the alternatives is as follows: 1. Alternative II (direct broadcast), 2. Alternative IV (hybrid), 3. Alternative III (rebroadcast), and 4. Alternative I (terrestrial system). When the present value of the total cost is taken (with an interest rate of 6%), it turns out that the ranking of alternatives I and III is interchanged, so that now the rebroadcast system and not the terrestrial system is the most expensive alternative. This conclusion has rather important implications, considering that all the commercial proposals made to India so far are for a rebroadcast system, involving a distribution satellite. But this analysis shows that from an economic point of view, it is the least desirable solution and even a terrestrial system, which is generally considered the most inferior and expensive alternative, is better than a rebroadcast system. It must, however, be pointed out that though the absolute difference in the discounted cost between the least and the most expensive alternatives is about $62 million, the relative difference is only about 22%. This is not to belittle the 22% difference, but only to point out that when the present value of the total cost is taken, the economic superiority of a direct broadcast satellite system is not as great as it was originally thought to be by many people. A normalized comparison of the four alternatives is given in Table 4 to indicate the relative differences in the discounted total cost.

TABLE 2

Present Value of Total Cost of Alternative Strategies of Providing TV Coverage

(Actual phasing of investment)

All figures in $ million

Strategy		1st 5 years	2nd	3rd	4th	Total	Least Cost Rankir
I Terrestrial System	*Total Cost (cap., repl., oper. & maint.)	56.0	83.6	219.7	396.6	755.8	4
	Average Total Cost (5 yr.)	11.20	16.72	43.94	79.32	37.78	
	Present Value of Total Cost						
	At 2%	52.70	71.40	169.90	277.90	571.90	4
	At 6%	47.10	52.60	103.20	139.30	342.20	3
	At 10%	42.45	39.25	64.20	72.00	217.90	3
II Direct Broadcast from Satellite	Total Cost	15.8	91.9	208.6	319.9	636.1	1
	5-yr. Average Total Cost	3.16	18.38	41.72	63.98	31.80	
	Present Value of Total Cost:						
	At 2%	14.88	78.40	161.30	224.00	478.58	1
	At 6%	13.29	57.85	98.00	112.50	281.64	1
	At 10%	11.98	43.15	60.95	58.15	174.23	1
III Rebroad-cast	Total Cost	52.6	130.6	237.7	301.9	722.8	3
	5-yr. Average Total Cost	10.52	26.12	47.54	60.38	36.1	
	Present Value of Total Cost:						
	At 2%	49.50	111.40	184.00	211.50	556.40	3
	At 6%	44.25	82.10	111.80	106.00	344.15	4
	At 10%	39.87	61.30	69.50	54.85	225.52	4
IV Hybrid	Total Cost	22.9	96.5	229.9	328.1	677.4	2
	5-yr. Average Total Cost	4.58	19.30	45.98	65.62	33.80	
	Present Value of Total Cost						
	At 2%	21.55	82.40	178.00	230.00	511.95	2
	At 6%	19.28	60.75	108.00	115.30	303.33	2
	At 10%	17.37	45.30	67.20	59.60	189.47	2

*Source of data for undiscounted total cost: Schramm-Nelson report

TABLE 3

Phasing of Investment or Pace of Implementation

(As % of Total Investment)

Strategy	1st 5 years	2nd	3rd	4th	Total
I Terrestrial System	7.4	11.	29.0	52.5	100
II Direct Broadcast	2.5	14.4	32.8	50.3	100
III Rebroadcast System	7.26	18.05	32.8	42.89	100
IV Hybrid System	3.4	14.1	34.0	48.5	100

TABLE 4

Normalized Comparison of Present Value of Total Cost

(Taken from Table 2)

Interest Rate

Strategy	0%	2%	6%	10%
I Terrestrial	119	119.5	121.7	125.2
II Direct Broadcast	100	100	100	100
III Rebroadcast	113.8	116.3	122.3	129.5
IV Hybrid	106.5	107.1	107.7	108.9

TABLE 5

Expansion of Population Coverage
(as a %) for alternative systems

Strategy	1st 5 years	2nd	3rd	4th	Total
I Terrestrial	8	9	27	40	84
II Direct Broadcast	2	17	36	29	84
III Rebroadcast	18	17	24	25	84
IV Hybrid	17	16	25	26	84

4.6 Sensitivity analysis

4.6.1 Rate of interest

The analysis has shown that the cost ranking changes when the present value is taken. This suggests that the ranking might be different for different interest rates used for computing the present value. To determine the extent of influence of this variable, the analysis has been repeated for two other rates of interest - one, 4% less than what was originally chose, and one 4% more, i.e., 2% and 10%. The results of these calculations are also shown in Tables 2 and 4.

From these it is seen that for an interest rate of 2%, the discounted cost figures have the same ranking as those of the undiscounted total costs. This is to be expected since discounting at 2% is almost as good as not discounting at all. (0 interest rate.) The second observation is that the cost ranking for 6% and 10% interest rates is the same. This shows that somewhere between 2% and 6%, the rate of interest changes the cost ranking; below that figure the ranking is the same as for undiscounted cost, and above that figure the ranking of the alternatives is, in the order of increasing cost, as follows: II, IV, I and III.

4.6.2 Phasing of investment (or pace of implementation)

Since in this analysis the concern is with the present value of investments made over the next 20 years, conceivably the phasing of investments, or the pace of implementation of the alternatives, can affect the present value and, consequently, the cost ranking of the alternatives. As mentioned earlier, the calculations shown in Table 2 are based on the feasibility, and, more importantly, the tentative plans of the Government. The phasing of investment is as indicated in Table 3, and as the figures here show, the pace of implementation is not uniform for the four alternatives. For example, only 2.5% of the total investment is made in the first five years for the direct broadcast system, while the corresponding figure is 7.4% for the terrestrial system.

To test the sensitivity of the ranking to the phasing of investment, the analysis has been repeated for a hypothetical and uniform rate of expenditure for all the four systems. The results of this are shown in Table 6. Here, it is assumed that for all the strategies, 10% of the total investment would be made in the first five-year period, 25% in the second, 35% in the third, and 30% in the last. With this assumption, it is seen that the ranking is different from that obtained in Table 2, though it does not vary for the three interest rates considered. This exercise is just to see how the ranking changes with the pace of implementation. However, since the phasing assumed is purely hypothetical and arbitrary, the rankings in Table 6 should not be taken seriously for purposes of evaluating the alternatives.

TABLE 6

Present Value of Total Cost of Alternative Strategies of Providing TV Coverage

(Assumed hypothetical phasing of investment for successive 5 Yr. Periods: 10%, 25%, 35% & 30%)

(All figures in $ million)

Strategy		1st 5 yrs.	2nd	3rd	4th	Total	Least Cost Ranking
I Terrestrial System	Total Cost	75.58	189.00	264.58	226.64	755.80	
	5-yr. Aver. Total Cost	15.12	36.8	53.0	45.4	37.79	
	P.V. of Total Cost:						
	At 2%	71.2	157.1	205.0	159.0	592.3	4
	At 6%	63.5	115.9	124.7	79.7	383.8	4
	At 10%	57.4	86.4	77.4	41.3	262.5	4
II Direct Broadcast from Satellite	Total Cost	63.61	159.00	222.61	190.88	636.10	
	5-yr. Aver. Total Cost	12.70	31.8	44.6	38.2	31.8	
	P.V. of Total Cost:						
	At 2%	59.8	135.8	172.3	133.7	501.6	1
	At 6%	53.5	100.2	104.9	67.1	325.7	1
	At 10%	48.2	74.6	65.1	34.7	222.6	1
III Rebroad-cast	Total Cost	72.18	180.8	253.08	216.64	722.80	
	5-yr. Aver. Total Cost	14.5	36.2	50.6	43.4	36.1	
	P.V. of Total Cost:						
	At 2%	68.5	154.5	195.5	151.9	570.4	3
	At 6%	60.8	114.0	119.0	76.3	370.1	3
	At 10%	55.2	85.0	73.9	39.4	253.5	3
IV Hybrid	Total Cost	67.74	169.30	237.04	203.32	677.40	
	5-yr. Aver. Total Cost	13.53	33.85	47.4	40.6	33.8	
	P.V. of Total Cost:						
	At 2%	63.6	145.0	183.2	142.0	533.8	2
	At 6%	57.0	106.8	111.5	71.3	346.6	2
	At 10%	51.3	79.5	69.3	36.9	237.0	2

4.6.3 Technological break-throughs

There are certain other parameters for which a quantitative sensitivity analysis could not be done for lack of data. Their effect would, therefore, be indicated briefly in qualitative terms. The cost estimates for all the systems are based on what current and near-future technology can offer. In reality, however, technological breakthroughs are not likely to occur uniformly for both the space and terrestrial systems, since the R&D effort is not the same for both.

With higher power on the satellite, the cost of the receiver front-end augmentation would come down. On the other hand, since they have not yet been made commercially, the estimated cost could turn out to be lower than the acutal cost, particularly if they are to be made in India. If that is the case, clearly, alternatives II and IV (direct broadcast and hybrid systems) would become relatively unattractive. However, the estimate used is a conservative one, and the costs of electronic systems, unlike defense hardware, have a tendency to decline. It is difficult to make any meaningful projections for this so as to handle it in a quantitative manner for this analysis.

For the terrestrial system too, likewise, there could be significant technological improvements if not breakthroughs. For example, if super-power transmitters and 1000-foot antenna masts rather than ordinary transmitters with 500-foot masts are used, that would make alternatives I and III (terrestrial and rebroadcast systems) relatively more attractive. But there is no information on their costs and feasibility in the Indian context.

In view of the limitations on capability and resources for programming as well as in receivers, only a one channel system has been considered for this analysis. At a later date, there would be a need for more than one channel. Expanding channel capacity would change the costs differently for the four systems, and it is perhaps more easily done for a satellite system than for a terrestrial system, though it would mean a heavier and more expensive satellite. It must, however, be remembered that the cost of the satellites is a rather small fraction of the total cost (slightly over 11%). The major addition to cost in expanding into a multi-channel operation is obviously in programming costs, which would be somewhat equal for all the systems, given the requirement of local programming.

4.7 Conclusions

The four alternatives are now evaluated using the criteria spelled out in Section 4.2 as yardsticks, which might be recapitulated as: cost, reliability, initial population coverage (say in the first ten years), and flexibility. Population coverage provided by the various alternatives is given in Table 5. The evaluation using these yardsticks is done in tab ular form, as shown below, and speaks for itself.

RANKING* OF ALTERNATIVES USING THE FOUR DEFINED CRITERIA

	STRATEGY	Total discounted cost	CRITERIA Population coverage in 1st 10 yrs.	Reliability	Flexibili'
I	Terrestrial system	3	4	1	3
II	Direct Broadcast	1	3	4	4
III	Rebroadcast	4	1	3	2
IV	Hybrid System	2	2	2	1

*1 indicates the best; 2, the next best; and so on.

From this table, it is easily seen that the obvious choice is alternative IV, the hybrid system. The table suggests that alternatives IV and III tie for the first place, if numerical points are given in an inverse relation to the ranking, and a total score is computed. But a table like this which merely gives numerical ranking can be misleading if it is erroneously inferred that all the four criteria are of equal importance, which they clearly are not. This table, for example, does not say, as Table 2 does, that the difference in discounted costs between alternatives III and IV is more than $40 million. The absence of any number 4 ranking for alternative IV clearly shows that it combines the advantages of II and III. It is interesting to note that only alternative IV has no number 4 ranking, while all the other three alternatives have at least one number 4 ranking against them. Alternatives I and II are somewhat antithetical; one is strong where the other is weak (e.g. cost and reliability). They can both be dismissed rather quickly.

An exclusive direct broadcast system is undesirable since it is extremely vulnerable to any failure in the satellite. The terrestrial system is too slow in providing adequate population coverage to help solve the urgent problems requiring instructional television. The apparent tie (if numerical points are assigned for ranks), between alternatives III and IV is easily resolved in favor of the latter because of the $40 million cost difference, and moreover III is the most expensive of all the systems. Though all the systems yield an ultimate population coverage of 84%, the growth of this over the years, particularly the extent of coverage provided by the end of the first ten years, is different for the four alternatives. Conceptually, this fact can be made use of to discount the "benefits" (i.e. population coverage) accordingly. The difficulty, however, in doing this is that the benefits are not expressed in monetary terms. Therefore, to handle this quantitatively, percentage of population covered in the first ten years per $1 million invested in each of the alternatives, is used as the measure to simultaneously take into account the varying cost and population coverage of the alternatives in the crucial first ten years. This is nothing but a benefit-to-cost ratio. The results of this calculation are indicated in the table below, which again show the superiority of the hybrid system over the others.

	STRATEGY	Present value of outlay for first 10 yrs. (in $ million)	Population covered in first 10 yrs. (as a % of total)	Percentage of population covered in 10 years per $ 1 M.	Ranking of alternatives
I	Terrestrial	99.70	17	0.171	4
II	Direct Broadcast	71.14	19	0.266	3
III	Rebroadcast	126.35	35	0.277	2
IV	Hybrid	80.03	33	0.412	1

4.8 Limitations of analysis

The chief limitation of this analysis lies in somewhat deliberately overlooking the fact that a satellite can be put to multiple uses besides television, with rather modest increments to its cost. For example, the provision of point-to-point communication capability on any operational television satellite for India is very likely, since it is economically attractive and, moreover, there would not be a demand for television programs 24 hours of the day. (Though a considerable amount of the non-broadcast hours could be used for feeding programs into video-tape recorders located at various stations for subsequent use, instead of physically sending tapes to the stations.) The additional point-to-point communication capability can change considerably the economics of a satellite system, in view of the revenue that can be earned from meeting the requirements of domestic telephone, telegraph, telex, etc. communication between the major cities of the country. This defect in the analysis can be rectified by taking into account the revenue that can be earned by such anciliary operations being done with each of the four systems.

(The same microwave links which interconnect television stations can also provide domestic telephone, telex, etc. within the country.) But these considerations would make the analysis rather complicated, and since also data is lacking to do a good analysis on them, they have been consciously omitted from this study. A second limitation - due to lack of precise data - is that this analysis does not indicate what the marginal cost of providing coverage is for each of the alternatives. If this were known, then one could decide whether 80% of 85% is a worthwhile target to shoot at or not, and whether the incremental cost of extending the coverage from say 70% to 80% or 85% is commensurate with the additional coverage of population obtained. Unfortunately, population coverage data is too gross to yield this information. Unless the exact location of the individual stations and receivers is known, it is not possible to compute the marginal cost of coverage. This is an important aspect for further study.

The airborne system alternative is treated separately in the next section, primarily because the comparison would not be a fair one since the airborne system does not provide national hook-up and also has greater channel capacity. Also, data is lacking on detailed costs of the system. Actually, it should not be considered as an exclusive alternative. As the following discussion will indicate, it is very attractive for India and merits experimentation at least in some areas, as an interim measure. Apparently, old airplanes do not have the glamor of a direct broadcast satellite. It is also felt that the technological and industrial spin-off of a satellite system is far greater and more attractive to India than that of an airborne system. An earlier proposal[29] for an airborne system, made by Westinghouse, called for large expenditures in foreign exchange and high operating costs. For these reasons, scant attention has been paid so far in India to this system.

4.9 Airborne television system

Only two studies have been made of a possible system of airborne television for India, one by Westinghouse Electric International Company[29] in 1966 and the other by the Indian Institute of Technology, Kanpur, a summary report of which was released a few weeks ago.[30] The idea grew out of the Mid-West Program of Airborne Television Instruction (MPATI), which has been operating successfully since 1961 serving schools in six Midwestern states of the U.S.[31] A good account of this project is contained in the Unesco series of case studies.[14] The Westinghouse Electric Corporation had pioneered experimentation in this field way back in 1946, and the system was called 'STRATOVISION'. It has a potential coverage of 5 million students in 13,000 schools, scattered over six states. Many tests were carried out by Westinghouse since then and it was run on an experimental basis till 1961, when under the direction of MPATI, the system became an operational one. Essentially, what is done is to extend the area of coverage manyfold (about 16 times) from about 8,000 square miles in the case of an average ground transmitter to an area of 125,000 square miles (or a circle of 200 miles in radius), with the increased height obtained by making transmissions from an aircraft kept flying at an altitude of about 23,000 feet. The facility of increasing the area of coverage by a factor of 16 is obviously very attractive for a country like India in view of the saving in both money and time required for the expansion of television coverage, compared to a terrestrial system.

4.10 Description of system

The description of the system that follows differs in some important aspects from what is advocated in both the studies referred to above, though it is closer to the one recommended by the Kanpur study. An important difference between the airborne system and the other four systems discussed earlier is that, unlike these other systems, national hook-up capability to provide a common program to the whole country is not possible with the exclusive use of airplanes. This facility could, however, be provided with a distribution satellite connecting ground stations which would relay the program through the respective airplanes flying over these ground stations, for extending nationwide coverage to conventional receivers. The Kanpur study recommends this latter system using a combination of airplanes and a distribution satellite to provide national hook-up, and to serve domestic point-to-point communication needs. In essence, this system envisages the use of 15 aircraft to cover the whole country, each fed by a separate program originating source on the ground, so that local programming needs are met. Since the state of Kerala is too narrow and small to be covered effectively by an airplane, it would have to be provided with a terrestrial system. The major improvement of the Kanpur proposal over the Westinghouse one is that in the former, program origination would be from the ground and not from the aircraft. This facilitates real-time programming (and hook-up if a satellite is also used), as well as the elimination of video tape-recorders and ancillary equipment from the aircraft, resulting in a saving of money, and aircraft payload by about 4,000 pounds.[31] Each aircraft would carry television transmitters, monitoring, navigational and communication equipment, and would fly in a specified circle of 10-mile radius at an altitude of about 23,000 feet and transmit programs by means of a gyroscopically stabilized and hydraulically operated turnstile antenna. The payload required is about 10,000 lbs. and a detailed study made by Westinghouse showed that of all the available types of aircraft, a Douglas DC-6B, a four-engined prop, is best suited for the purpose.[31] Its advantages are that it is the least expensive, has a pressurized cabin with adequate space, its maintenance is easy, has the most reliable engines, and can operate from 6,000-foot runways. The only disadvantage is that, compared to a jet like the Boeing 707, the altitude capability is lower and the operating costs perhaps somewhat higher. But these advantages of a jet are far outweighed by its much higher capital cost. Also, DC-6Bs could be purchased in the surplus market quite easily and at a low price (perhaps $100-200,000), as against the price of a new one, which is about $500,000, unlike a Boeing 707, which has much more demand even on the surplus market. The continuous flight time of a DC-6B at 23,000 feet altitude, with a 10,000 lb. payload and 45 minutes of reserve fuel for diversion to a distant airport in case of bad weather, is over 5½ hours. With two fully-equipped aircraft, each region would have a continuous 11-hour service daily, which is a very substantial amount of time. Even without back-up aircraft, the reliability record of the system has been found to be over 90% and with backup aircraft the figure is over 98%.[31] It is neither necessary nor desirable to have backup aircraft for each region. A back-up aircraft each, located in the North, South, West, East and Central regions might be adequate for all the 15 stations. The payload of the aircraft can accommodate 2 or even 3 channel capability. It seems desirable to provide two channel capability, even though both of them would not be used fully in the beginning. By allocating different frequencies for adjacent regions, it appears possible to cover all the fifteen regions with just six frequency band assignments, rather than 12, suggested by the Kanpur study, for a two-channel capability. Conservation of frequency spectrum is an added advantage of the airborne system. Since it covers only 90% of the area of the country, unfilled pockets in populous areas may be covered by terrestrial translator stations.

4.11 Suggested modifications

The Kanpur study envisages the use of UHF frequencies for the transmissions from the aircraft, and ground stations in each of the 15 regions to serve the area directly beneath the aircraft, where the quality of signal is thought to be unsatisfactory. In the opinion of the author, which was confirmed by expert technical advice (from Lincoln Laboratory), both these features need to be changed. Firstly, there is no reason why India should use UHF frequencies for an airborne system. For the MPATI, UHF is used because all the VHF channels are completely occupied by terrestrial stations and the transmissions from the aircraft are received in six states. Since one is beginning virtually with a clean slate in India, the problem of frequency spectrum crowding for VHF is not an acute one, and it should be possible to assign six VHF channels without too much difficulty. In India 8 channels have been alloted for the use of television in the VHF band: 2 in Band I(41-68 MHz) and 6 in Band III(174-216 MHz). Since UHF receivers are not made in India, while VHF ones are, it is better to use the latter for an airborne system. Moreover, the cost of electronic equipment, transmitters, receivers, etc., is higher for UHF than for VHF. It also seems desirable to increase the power of the airborne transmitter from 3 KW to 5 KW so that reception even in the fringe areas will not require the use of height diversity antennas and parametric amplifiers (which might otherwise be necessary), and the higher signal strength will permit the use of the least expensive type of receiver.

The second feature which needs modification in the Kanpur proposal is the small ground transmitter in each region to serve the area immediately beneath the aircraft. The reception would be unsatisfactory if a horizontally-polarized turnstile antenna is used on the aircraft, because of the null-effect produced. It is learned that this problem can be tackled satisfactorily by using circular polarization and also by designing the last few elements of the antenna to have closer spacing so as to avoid a null. This would then obviate the need for the additional ground transmitting stations in each region, resulting in a considerable saving.

Special problems

A problem with the airborne system is the undesired extraneous amplitude modulation upon the picture caused by the vibration of the aircraft and the signal reflected from the rotating propellors. Experience with the MPATI showed that these problems could be solved by shock mounting the equipment to minimize the effect of vibration, by using better quality components, by synchronizing the aircraft propellors, and by incorporating a compensating negative feedback loop.[31] Critics of the system point out that operation of an airborne system would become difficult, if not impossible, in places like Bombay and South-western parts of India, because of the heavy monsoon. But this should not be a problem since during the rainy season aircraft could operate from airfields in other nearby states, where the monsoon is not heavy. For example, planes could operate from Gujerat to serve Maharashtra during periods of heavy rainfall. The operating altitude of the aircraft, 23,000 feet, is above most cloud systems and should not be affected by any except the worst thunderstorms. Once the aircraft is at its designated location rain poses little problem for transmission since there is virtually no attenuation and absorption due to rain, in the VHF band.

4.12 Advantages of airborne television

The chief attraction of this system is that is is simpler than any of the four alternatives discussed earlier and can be put into operation in a short time. It has not been possible to make a detailed cost estimate for this system; however, as a rough, ball-park figure, the additional cost of installing this system, viz., the cost of the aircraft and associated equipment and the microwave relays required to beam the programs to the aircraft, is estimated to be about $50 million, which is not a very large sum, considering that it provides close to nationwide coverage in about 3 years' time. This excludes the cost of studios, receivers, etc., which would be required in any case, and the operating costs of the system. The main airframe of these planes have a virtually indefinite life, but engines and other parts require periodic replacement. The technology involved for this system is completely within India's capability and it can be deployed soon enough to make a dent in the urgent problems desperately needing a mass medium like television. The planes would, however, have to be bought from outside, as the Indian-made AVROs might prove to be a little small for the job. However, the possibility of using an AVRO for a one-channel system merits a detailed examination. But it should not be difficult to buy DC-6Bs in the surplus market. An additional attraction of the system is that these aircraft could also be used as weather stations, since they are there up in the sky anyway for 11 hours a day.

CHAPTER 5
PUBLIC POLICY ISSUES

5.1 Introduction

In this chapter attention will be focused on six major issues of public policy in relation to a satellite television system for India. All of these are rather controversial questions on which considerable debate has been going on for quite some time. While there are many intangibles involved here, the discussion that follows points some of the more important considerations underlying these issues. The ultimate decisions depend upon priorities or importance attached by the Government to the various goals. Being matters of policy, they are not black and white, unlike some of the other more tangible questions relating to technology or costs.

5.2 The relative roles of television and radio

It is pertinent to ask why radio should not be used more extensively for instructional purposes instead of television, which is far more expensive. As a matter of fact, this question is being debated quite seriously. Since 1956 sound broadcasting has been used for disseminating agricultural and other instructional programs to villages equipped with community radio receivers. In 1956 a Unesco-sponsored project was started in the state of Maharashtra with Radio Rural Forums organized in 144 villages and half-hour biweekly broadcasts relating to agricultural practices and other topics of rural interest were made from the Poona station of All India Radio.[33] This was modelled after the Canadian (1941)[12] and French (1952)[32] experiments and came to be popularly known as the Poona Experiment. A systematic field evaluation of the project found the programs very effective and successful.[33] Encouraged by the success of the Poona Experiment, the Indian Government duplicated the effort in many other states, but with rather disappointing results.

On paper, there are more than 25,000 farm radio forums today, all over India, but it is accepted by Government officials that forums, with the exception of one or two states, have failed. It is not difficult to understand the present failure of the forums if the factors which led to the success of the Poona Experiment are known. This experiment was characterized by a high degree of motivation at all levels. To an extent the results could be due to a Hawthorne Effect operating, since the people involved were very conscious of the attention the project was receiving and they had to make it succeed, being a prestige project started with the collaboration of the Unesco. Partly as a result of this, resources - financial as well as human - were not stinted for the project. As Schramm points out, the experiment was conducted under very favorable circumstances: Maharashtra was one of the best administered states in the country and at least three of the five districts chosen for the project were known to have efficient organization at the village level and most of the villages involved were progressive.[33] None of these factors are applicable on a national scale, and clearly Government effort and resources were spread thin over too many states.

Added to these factors is another phenomenon, which is perhaps equally important: with the introduction of relatively inexpensive (less than $12) transistor radios in the market, they have become a part of the rural scene now as quite a few people in most villages own them and people no longer feel a great need to go to the village-square or school to listen to the community set, which is more often than not inoperative due to a breakdown or lack of battery replacement. Also, the novelty of radio has all but worn off in the villages, so that a community set has very little ability to attract listeners; people listen to it if they happen to be around, but do not show much enthusiasm in going to it. This has been observed in many villages. Though this is slowly, and to a smaller extent, happening for television too, because of its visual appeal it still draws a sizeable audience every day in the villages around Delhi, where the sets have now been in existence for more than two years. It is not really necessary for people to go to the community set to listen to the programs, as long as they do get the information from somewhere, either on their own sets or at a neighbor's place or even by means other than radio. However, the number of people reached would be much less in the absence of community listening. The Government feels that sound broadcasting for community reception is worthwhile and has mounted a massive program of installation of community sets, though the amount of time devoted to rural broadcasts is very small (only about 6% of the total time), compared to programs of music (44%), according to AIR's own analysis of regional broadcasts. The Chanda Committee has emphasized the need to reduce the time devoted to classical Indian music and increase educational and other instructional programs.[3] Today there are more than 200,000 community radio receivers located in the villages, though their maintenance is far from satisfactory and it is not known to what extent these sets are used. Their number is expected to go up to 400,000 by 1970-1971. Most of these sets are battery operated. About 52% of the country's area has been covered by medium-wave transmitters, while programs can be heard by about 75% of the population. The population coverage is expected to go up to about 85% in the next five years. It is estimated by the Government that the total number of radio receivers currently in use would be around 10 million. It is not known exactly how many of these are in the villages, though their number is growing at a rapid pace.

Though forums function in few villages, it has been observed that people do listen to the radio, particularly when music and light entertainment programs like radio-plays are on the air. With skillful programming, therefore, it should be possible to 'smuggle' in some instructional and educational information, without making it dull or 'heavy'. The problem of attracting audiences is quite similar to the one with television that is currently being faced with the

Delhi Rural Project. It is therefore essential and worthwhile to experiment with new styles of programming on the radio and with new ways of structuring the forums, as discussed in Chapter 1 regarding teleclubs.

It would also be useful to conduct a systematic study of the relative cost/effectiveness of radio and television under various conditions, in order to provide a quantitative basis for the Government to consider relative allocation of resources between these two media. Irrespective of the decision to expand broadcasting further, there is a need to make the existing service accessible more widely. To do this, it is necessary for the Government to take steps to increase the production of inexpensive domestic transistor radios and batteries to go with them. Shortages of the latter are quite notorious. There is considerable interest in the Unesco in popularizing low-priced, single-band radios and the International Telecommunications Union has been requested to draw up specifications for mass production of inexpensive sets for use under tropical conditions in the developing countries.

The least expensive single-band transistor set in India is currently priced at about $12. There appears to be considerable scope for reducing this price to about a third of this figure which would then certainly place it within the purchasing power of many more people, both in the cities as well as in the villages. There is really no reason why this cannot be done with proper Governmental action, since such sets are available in the international market for $4. Many small-scale producers are now assembling these sets, in Delhi and many other places, as a 'cottage-industry'. They deserve all encouragement and help from the Government as they have been able to make increasingly cheaper sets. The recent increase in excise duty on transistors and other radio components was a step in the wrong direction. Standardizing inexpensive designs, reducing or even abolishing excise duty and other taxes on single-band sets, expanding production capacities to realize economies of scale, abolishing license fee on single-band sets, are but a few of the many policy initiatives which merit the serious consideration of the Government in this connection. This is not to imply that individual reception should be emphasized as against community reception. Efforts for both need to be stepped up. The point is that it is not enough to install community receivers in more and more villages, particularly when they are not provided with adequate support to ensure that they are usable and also well utilized. Since Government outlay on all this is likely to be far less than what it would be for a national satellite television system, and the payoff much quicker, the need to pay more attention to this vital area should not be lost sight of in all the excitement of a satellite television system. It must also be emphasized that the two are not exclusive alternatives, since, while both are relevant, in the absence of television radio can accomplish a great deal if the effort is well-organized.

5.3 Rural versus urban location of television transmitters

An important and as yet somewhat unresolved question of policy is whether emphasis of coverage should be on rural or urban areas or both. As mentioned earlier, in Chapter 1, AIR favors installation of transmitters in the cities, on a priority basis and the first phase of its plan envisages television stations with restricted facilities in Srinagar, Bombay, Calcutta, Madras, Kanpur and Ahmedabad, in addition to the expansion of the Delhi station. The chances of this plan being approved seem quite high and, sooner or later, stations will also come up in all the state capitals. While the potential demand for domestic television receivers in each of the big cities could easily be in the tens or even hundreds of thousands, for a long time to come it is unlikely that, except in the most prosperous villages, there would be any significant demand for domestic television sets in the rural areas; the only set in the village, meant for community reception, would have to be provided by the Government. Even if the Government takes the responsibility to provide community sets, it would easily take 10 to 20 years before every village in the country has a set. In the same period ownership in the urban areas could go up to a few millions of sets. Also, if transmitters are located in rural areas, the quality of the signal would be somewhat inferior for the cities. Whereas, for a transmitter located in a city, the urban part falling within the area of coverage of the transmitter, constitutes less than 10% of the total area, the remaining being rural.

For taller transmitter towers the urban area constitutes a still smaller percentage of the total area of coverage. In view of the substantially lower man-made (electrical) noise in rural areas, compared to the cities, the signal quality would be satisfactory in the villages if the transmitters are located in the cities. Therefore, while the location of transmitters in the cities yields substantial rural coverage also, their location in rural areas would result in an essentially rural system. Because of the very high concentration of population in the big cities, transmitters in the five big cities alone have a potential urban coverage of about 20 million people. Their total coverage is, of course, much larger because of the sizeable rural population falling within the transmitters' reach. In view of the concentration of population in the cities, the per capita cost of coverage obtained would be much lower for urban location of transmitters.

The fact that only slightly over 10% of the villages are electrified, makes location of transmitters in rural areas and emphasis on rural coverage unattractive. The rural electrification program would take a long time and the only receiver authorized by the Government requires electric power as it is not a solid-state design. Experience with the Delhi project also shows how important it is to be able to tackle the problems of maintenance and logistics involved in a rural system. A stronger rural infra-structure than what is currently existing is also a pre-requisite. Without motorable (at least by a Jeep) roads and proper facilities for viewing, a television set cannot even be installed in a village. Finally, it must be noted that the political pressure for locating transmitters in the cities is great while there is hardly such pressure for emphasis on rural coverage. The argument for rural coverage is that while most urban and semi-urban areas, where the rate of literacy is higher, have access to a host of mass media, rural areas are considerably isolated. Since in India 82% of the population is rural, 76% is illiterate and 70% is involved in agriculture, both in terms of the potential use of the medium as well as need for it, rural coverage can claim higher priority. However, as already discussed, since transmitters in cities can meet rural needs as well, the case for rural location of transmitters becomes very weak. With appropriate selection of locations and the use of 1000-foot rather than 500-foot antenna masts rural coverage can be further increased, in addition to the enormous urban population served by such a system.

5.4 Policy for television receivers

Perhaps more controversial and important than the earlier two issues discussed is the question of Government policy with regard to television receivers. The importance of receivers cannot be overemphasized, as the investment in the sets is, by far, the largest single element in the whole satellite television project, and is about 73% of the total cost for a hybrid system, which represents 273,000 conventional and 654,000 'direct' receivers and includes replacements over a

20-year period, while the cost of the satellites in orbit is a mere 11.5%.[1]

For more than two years now, the Government has banned all imports of TV receivers into the country. Four private companies - two large ones (Telerad in Bombay and J. K. Electronics in Kanpur), and two consortia in the small-scale sector - have been licensed by the Government a total capacity of 30,000 sets (10,000 each for the two larger companies and 5,000 each for the two smaller ones), using the design developed by the Central Electronics Engineering Research Institute (CEERI), Pilani, a Central Government laboratory under the Council of Scientific and Industrial Research, of the Ministry of Education. CEERI is to receive a 2% royalty on sales from these companies for making the design and production know-how available to them. Regular commercial production has just commenced at both the large companies and the first set of J. K. Electronics was introduced in the market last month (April 1969). These sets have a 21" screen, operate with monochrome signals and conform to CCIR specifications for Type B receivers (625 lines and 50 cycle frequency). They have a foreign exchange component of about 20% and sell for $240 (Rs.1800). The picture tube, deflection yoke and a few other components are imported. Both the larger units claim that they could produce 100,000 sets a year, in 3 to 4 years' time, if the Government licenses additional capacity and foreign exchange. But considering that they are already behind schedule by almost a year, and the time-constants of

Governmental decision-making being what they are, it seems rather doubtful if the production could be increased to such high levels in the near future. It must also be kept in mind that the nature of a production facility turning out 100,000 sets a year is quite different from that producing 10,000 sets and would certainly involve additional foreign exchange for importing sophisticated, high-speed automatic equipment. Therefore, even if these companies are able to meet the demand for sets for the next few years, it is likely that demand would outstrip supply when an operational nationwide satellite television system comes into being.

A second problem is that since the receivers currently produced, all use the tube design developed by CEERI, they cannot be used in most (about 90%) of the villages, unless some form of power generation equipment like gasoline, windmill, bicycle, or animal-driven generators are provided in the villages to operate the sets. It would be necessary to use them as an interim solution. A more satisfactory answer would be to produce a solid-state receiver, but one does not know how long this would take. CEERI is reported to be working on such a design currently and is expected to take it up vigorously once all the production problems with the present tube-design are completely debugged. CEERI took about six years (1961-1967) to produce the first conventional television receiver. Its development was undertaken voluntarily and not under contract to industry or the Government. It certainly would have been done in a much shorter time had a deadline been set. In all fairness, it must also be added that the quality of the set produced in CEERI's own pilot production facility (set up to debug production problems) has been shown to be better, in terms of picture 'resolution', compared to many imported sets.

Many people have pointed out that the CEERI receiver is a high-cost and obsolete design. They question, why, instead of spending six years "designing" a tube-receiver, CEERI did not follow the simpler and pragmatic, but perhaps less exciting, alternative of getting hold of any good imported solid-state receiver and substituting the components with indigenous ones. However, it would be unfair to blame CEERI for either the high cost of its receiver, or for producing a tube - rather than a solid - state design. The high cost is not because of the design but is due to the high cost of components in India, and, moreover, economies of scale cannot be effected unless production is on a mass-scale. CEERI could not have known when it started work on the receiver many years ago that there would be a need for solid state sets, for use in the villages. While if the AIR plan were approved by the Government, stations would be established in the cities - where tube sets make more sense than battery operated ones. So, it is Government indecision and a lack of a clearly spelled out policy on television which makes planning difficult in this matter. Also, a serious error of policy on the part of the Government lies in its decision to license four units with a total annual capacity of 30,000 sets. This diminishes the possibility of bringing down the price of the receiver from $240 to anywhere near the international price of a comparable set, around $125. The Government has made similar mistakes in the past for other goods like automobiles, but does not seem to have learned from them. The demand potential for receivers in the country is large enough to warrant licensing a couple of units with an annual capacity each of 50,000, if not 100,000 sets. Though the policy of forbidding foreign collaboration to save foreign exchange and to encourage indigenous scientific and industrial capabilities is good, to insist on using the CEERI design and to license four units seems rather unjustifiable. Since the decision to license the manufacture of receivers was taken before satellites were considered, the need to take a fresh look at it is all the more heightened. The set to be used for direct reception from a satellite involving a special front-end and audio-channel selector, is a rather different animal, and as suggested in section 3.3.6, it seems desirable to take up the production of a new comprehensive design for direct reception, on a large scale, in addition to the conventional receiver.

5.5 Organizational issues

5.5.1 Organization for a satellite television project

The question that would be examined here is, what kind of an organizational structure would be most appropriate for a national satellite television project. Government policy on this question is, as yet, unformulated, though many different proposals are aired from time to time by various people.

The Government is reported to be considering the whole matter and is expected to come to some definite conclusions, hopefully in the near future.

Many Government departments and agencies, belonging to different ministries would be involved in a complex venture like this, which cuts across conventional lines demarcating the responsibilities of individual organizations. The following organizations would seem to have an involvement with such a project: 1. Indian National Committee for Space Research, 2. Department of Atomic Energy, 3. All India Radio, 4. Ministry of Information and Broadcasting, 5. Ministry of Health and Family Planning, 6. Ministry of Food, Agriculture, Community Development and Cooperation, 7. Ministry of Education, 8. Ministry of Communications, 9. Central Electronics Engineering Research Institute (CEERI), 10. Indian Agricultural Research Institute, etc. Projects of this magnitude and nature have virtually no precedents in the Government. The Delhi Project has some parallels, but has far less complexity, both in terms of hardware as well as software, and is of a much smaller magnitude.

Under the present structure in the Government, it would seem that the brunt of the technical responsibility in organizing the project would devolve on the Department of Atomic Energy and All India Radio, since the former has the responsibility for the space segment and the latter for broadcasting. Of course, once the system is in operation more effort, activity and expenditure would be in the various user ministries like Education, Family Planning, Food and Agriculture, Communications, etc. This latter fact is somewhat overlooked amidst all the concern about the hardware. When so many organizations are involved, it would be inappropriate to put the project under the control of either one or both of the two technical organizations named above, since such an arrangement would neither be functionally meaningful nor conducive to good human-relations. Under such a set-up, it is not hard to visualize inter-organizational rivalry and a struggle for power and the consequent friction, counter-productive activity and a loss of cooperation, so vital for the venture.

Two alternatives could be considered. The first is the creation of a new autonomous organization, perhaps with the name 'National Satellite Commission', or some such title, on the lines of the Atomic Energy Commission, vested with adequate authority and provided with sufficient resources of its own. The Commission could be headed by a competent high official reporting directly to the Prime-Minister. It could consist of the Secretaries of the six relevant ministries, in order to enlist the full support of the organizations involved, and could be empowered to hire (or transfer) people from Government as well as outside organizations, to derive the full benefit of expertise required in the various areas. Day-to-day administration of the project could be under the control of a Project Administrator, reporting to the Commission. There could be divisions for the two technical components as well as for the various user elements of the project, each headed by a Director and responsible to the Project Administrator. This would, incidentally, be in line with the Chanda Committee recommendation that television should be managed by a new autonomous organization and not by AIR[3].

The second alternative is to work essentially within the present structure of the various ministries, without creating any new organization, but introducing certain important modifications. Under this system there would be one high-level committee consisting of the Secretaries of the various ministries involved in the project, to provide policy direction and coordination. This committee would be assisted by one or more committees or working groups, consisting of people drawn from the operating level of the different ministries, and would carry out the decisions of the policy committee, coordinate the working and day-to-day operation of the project. There would be an understanding, perhaps in the form of a written memorandum or agreement, as to the inputs and responsibilities of the respective organizations. The important modification from the present Government structure is that it is envisaged that AIR would own and operate the production facilities of transmitters, studios, etc., and make time available to the various user ministries, who would do the actual programming required by them. AIR would also have its own program staff for news, cultural, entertainment, and public affairs programs. The rationale behind this idea is that each ministry has its own experts who know best how the programming in that area should be done and hence should develop their own program staff with whom the subject-matter specialists would work closely, rather than have AIR staff, who produce all kinds of general programs, handle the various subjects. Also, when several independent groups do the programming, a competitive atmosphere is created which would bring out the best of each organization. The idea could be extended further by having competitive programming groups even within each user organization, so that there is a constant striving towards excellence through more free experimentation with different programming ideas and techniques.

While, in principle, the second alternative looks good, it has two serious drawbacks. Firstly, a loose organization under tiers of omnibus committees is very ineffective to get work done. This was the exact style or management of the Delhi Project, and one of the important lessons learned from it was that a committee could not run a project of that nature. Rapid proliferation of committees and sub-committees with greater delays in decision-making and greater need to 'coordinate' would soon result and one would have the classic Parkinson's example. The second difficulty relates to the idea of multiple programming groups. As mentioned in Chapter 3, trained programming talent is extremely scarce, making it very difficult to implement this idea. Also, such a system means considerable duplication of effort and facilities which India can hardly afford. In the light of these disadvantages, the first alternative, namely, creating a new 'National Satellite Commission' as described, seems more attractive than the second.

This is not to imply that the first system is falutless; it only seems potentially more effective. The success of any organization depends upon a host of intangibles like the capabilities of the individuals in key positions and no simple text-book theories of organization can suggest lasting practical solutions in a complex situation such as this.

5.5.2 Central and state control

The nature of the heterogeneity in India and the consequent problems for programming have been discussed in detail in section 3.5. The inescapable conclusion of that discussion was that local programming is a must. So, a few words are in order here on the question of control and management of local programming.

Since the last general elections in 1967, 'non-Congress' Governments came to power in many states, a fact which has important implications for the management of a Central Government-controlled medium like radio or television broadcasting. The issue of rights of the individual states came to a head when AIR Calcutta censored the speech of a Minister of the United Front (Communist) Government of West Bengal, as it was considered to be politically disruptive. The incident caused a furore and though an attempt was made to evolve some kind of a code to avoid such occurrences, the deeper and more important issue at stake, namely, Central versus state control of broadcasting media, remains unresolved. The problem did not arise before because, till the last elections, no party other than the Congress came into power in the states, except in Kerala, for a short period. It can be argued that it is undemocratic and an infringement on the right of an elected leader of a state Government, for the Central Government-controlled broadcasting organization (AIR) to censor his speech. It is hardly appropriate to go into the legalities of the question here. The incident has been cited to show, as an example, some of the kinds of serious political problems that need to be resolved before embarking on a nationwide satellite television system. Cooperation and understanding between the Central Government and the various state Governments is vital for satellite television in India. The issue is a very delicate one and can cause serious problems. It is not hard or unrealistic to visualize the converse of the incident described above: a state Government could refuse to cooperate with the Center if it thinks the programs to be politically unsuitable, or even more fundamentally, if it sees the whole project as an instrument to win back lost votes for the next election. Since radio and television are powerful media, complaints of abuse and political propaganda might easily be made by opposing parties in power, when the medium is operated as a monopoly of the Central Government.

5.5.3 Multipurpose use

A domestic or national satellite can be used for many purposes besides television: point-to-point communications (telephone, telegraph, telex, facsimile, etc.) within the country, meteorology, geodesy, navigation and defense communication. A satellite launched for one purpose can also be used for other purposes with additional equipment put on it at extra cost. Obviously, a balance must be struck between meeting additional needs and over-complicating the satellite, involving more time and money.

In the Indian context air traffic is unlikely to justify navigation by a satellite for a long time to come and the requirements for defense communication impose certain technical constraints which may greatly complicate or even prove incompatible with a television satellite. Though requirements for the other uses have not been well-evaluated, it appears advantageous to use it for point-to-point communication in addition to television. The hardware on the satellite required for meteorology and geodesy is considerably different from that used for communication. Studies made by the Indian Post & Telegraphs Department (Telecommunications Research Center) have revealed that a synchronous satellite is economically worthwhile for point-to-point communication only between the four or five larger cities in the country which are already being connected by terrestrial links. The traffic between these cities is so large that whatever channel capacity is offered by a satellite can be used, in addition to the terrestiral links. For this reason, it is very likely that any operational satellite for India would have a point-to-point communication capability in addition to television. This is also very desirable in view of the revenue that could be earned from serving the internal communication needs. However, with the ATS-F satellite, the use will be restricted to television only. The question of multi-purpose use has also implications for control and organization of a satellite project.

5.6 Financing

Capital costs of the ground segment, to be borne by India, for the project using the ATS-F satellite, inclusive of receivers and receiver maintenance centers is estimated at \$6.64 million. Excluding the investment already existing at Ahmedabad and Delhi, the additional outlay comes to \$4.2 million, which is not difficult for the Indian Government to provide. This project involves only 5,000 receivers. This is a very trivial sum compared to the 20-year costs of a national system. As indicated in Chapter 4, the total undiscounted cost of a nationwide hybrid system, for a 20-year period, is about \$677 million. This cost must be weighed against the benefits of television, some of which are quite intangible, and for many tasks like improving and expanding education, teacher training, etc., television is much cheaper and quicker than alternative means. This cost can be viewed in proper perspective if compared with national income and Government expenditure on education. Details of these figures have been worked out in the Schramm-Nelson report. Suffice it to note that the average annual cost of a hybrid satellite TV system, over a 20-year period, is less than 0.05% of gross national income and less than 1% of expenditure on education. Providing about \$35 million a year for 20 years is not an impossible task for India, particularly if most of it is to be in rupees rather than in foreign exchange. However, in view of the competing demands for scarce resources, it is not an insignificant amount either. Besides the boost to education, agricultural development, industrial production, employment, etc., substantial direct revenues could be earned from commercial television advertising and point-to-point communications. The Government experimented belatedly, for the first time last year, with commercial advertising on radio and found it very lucrative. An annual revenue of $0.6 million (Rs.4.5 Million) was estimated from the limited operation in the state of Maharashtra alone. Radio advertising was also started in Delhi from April 1, 1969 for a total of 75 minutes a day and there are plans to introduce it at many other stations as well. Opportunities might also exist for assistance from the U. N. Development Program, particularly for foreign exchange required for software development and overseas training, and also the World Bank, the U.S.A.I.D., etc.

5.7 Foreign collaboration

The industrial base and physical facilities exist for many of the elements required for a satellite television project, as evaluated in Section 3.4.1. The key element, of course, is access to a satellite. NASA would provide the ATS-F satellite for a one-year period, assuming India would go ahead and sign the agreement for the proposed experiment. Since India cannot let all the investment in the ground segment be idle and wasted after the experiment concludes, planning for the post-experiment period (1974 onwards) will have to be done right now. Clearly, India does not have the capability to build a synchronous satellite by 1974. Since it is considered important in India to develop satellite know-how as soon as possible, an alternative generally mentioned is to buy the first operational satellite from one of the U.S. companies, to meet Indian requirements, and to acquire know-how from the same company to build the standby in India. This is more easily said than done. A satellite is not like any other piece of equipment to be bought off a shelf. The transaction would not be a purely commercial one, but one regulated by the Government of the country selling the satellite. Transfer of technology, competitive position of commercial manufacturers, possible diversion for military use, implications for aid - to and by other countries - are all vital issues having a bearing on this matter. It would be naive and unrealistic to expect any company in the U.S. (or any other country, for that matter) to give away satellite know-how to India easily; talk of collaboration by a company may be no more than an inducement to buy a satellite. Parting with highly prized and closely held technical knowhow, accumulated after spending millions of dollars on R&D, even for an immediate monetary gain, might hurt these companies' prospects of selling satellites in the future. Collaboration for theoretical studies is, of course, a different matter. The reluctance would be all the more, considering the military spin-off of space technology. When NASA has, reportedly, been unwilling to give the technical knowhow of even the Nike-Appache for the Indian scientific-rocket program, even though this rocket has little military significance, it is hard to see how know-how for a satellite would be made available. Launching would presumably be the responsibility of the company selling the satellite and unless NASA's willingness to launch the satellite is ascertained in the first place, India would not buy the satellite. The satellite and the launcher really go together though there is a very important difference to note: unlike the satellite which could be made by Russia and perhaps a few other countries, and many companies in the U.S., the only civilian organization in the world which has the capability to launch a satellite in synchronous orbit is NASA. Though it seems reasonable to expect at this point of time that the U.S. would be willing to launch satellites for India, the position of unique monopoly clearly gives great leverage to the U.S.

Responsibility for and control of programming would be completely Indian for the ATS-F experiment. It is inconceivable that direct control of programming would be anything but Indian for any future satellite as well. However, some people fear that there would be indirect U.S. control and influence in at least the following three ways. Firstly, since the satellite would be launched by the U.S. it would be under the physical control of the U.S. and theoretically it could be moved out of its assigned location over India, or the satellite power turned off, by command from an American controlled ground station (one or two of which would always have to be within the view of the satellite for telemetry and telecommand (station-keeping) purposes), if for any reason the nature of the political equation between the two countries should change. Secondly, there would be indirect, though negative and limited, control of programming, since India might not be allowed to disseminate views using the satellite, which are considered against U.S. interests. One wonders, for example, what the reaction of the U.S. Administration or the Congress would be if India denounces the policies and/or actions of the U.S. or its allies, on national television using an American satellite. Of course, India is not wanting a satellite for propaganda purposes, but the borderline between propaganda and information is rather fuzzy. Thirdly, what are the foreign policy objectives of the U.S. in making a satellite available to India? It could be asked if there would not be some unarticulated or implied expectations, or "invisible strings" and if they would not constrict Indian programming. Is the satellite meant to aid development or to reap political harvests in terms of greater influence, or both? Objectives in these matters are rarely black and white, and there could be a combination of various considerations. Different branches of the U.S. Government could have different objectives: NASA's primary interest may lie in the testing and demonstration of the direct broadcast technology; the U.S.A.I.D. may see this as an effective form of developmental aid; and the State Department may see this as a tool for increasing U.S. influence in India and enhancing her prestige and goodwill in general, particularly in the Third World. And all these objectives could be operating simultaneously.

Perceptions on the Indian side, likewise, could be equally kaleidoscopic, depending upon who or which organization is viewing it. Attitudes and reaction to the idea of using a U.S. satellite range over a wide spectrum. There are some who see it as a boon of the space-age, and some who see it as a symbol of 'imperialist domination'. People have asked: "Would it be withdrawn if there is another outbreak of hostilities with Pakistan? Is it a bait offered for signing the Non-proliferation Treaty? Is it to make up for the lead stolen by Russia, in influence, ever since her initiative for Tashkent? Is it a spy in the sky to monitor India's nuclear capability?", etc.

All these are highly sensitive issues for both the U.S. and India. Attitudes on the Indian side would also be influenced by memories of the so-called 'VOA deal', of some years ago when fears of propaganda by Voice of America scuttled a project meant for the rapid expansion of rural sound broadcasting in India with American assistance. Yet another and more recent example of turning down U.S. assistance out of suspicion is the case of the proposed Indo-U.S. Educational Foundation. There is no doubt that, among other things, U.S. arms assistance to Pakistan, without which she would not have dared to attack India in 1965, has greatly tarnished the image of the U.S. in the eyes of the Indian public. This partly explains the fear and suspicion with which U.S. aid is viewed in India. Creating the necessary confidence to undertake meaningful programs of bilateral assistance is an important task for the U.S. It is beyond the scope of this paper to evaluate how widely some of the above mentioned concerns are shared in India, but it is important to be aware of the kinds of concerns in people's minds since they do exist.

These things should be kept in mind when negotiating agreements so as to ensure adequate protection of interests, but beyond that, it would be unfortunate if they dominate the thinking on the project and let valuable time and the opportunity slip away in the prognosticating process of looking too much at the 'gift horse in its mouth'. The Indian Government has been taking an inordinately long time in deciding on the proposed joint experiment with NASA; it is two years since the idea was first discussed and almost a year since the draft agreement has been prepared. Any further delay would hurt rather than help Indian interests and hold up the expansion of badly needed television in the country.

The concerns mentioned above raise the question of what other alternatives does India have in obtaining a satellite. Theoretically at least four alternatives suggest themselves: 1. obtain or undertake a joint venture with some other country like the Soviet Union, France or Canada, 2. try for a U.S. satellite under international auspices (say, channelled through the U.N.), 3. lease time on an Intelsat satellite, and 4. develop an indigenous satellite.

The difficulty with the first alternative is that no country other than the U.S. has actually built and launched a synchronous communication satellite. This is perhaps why the

Soviet Union has made no overtures (at least not publicly) to India to make a satellite available. It is also known that Russia, like the U.S., was unwilling to part with know-how for making scientific rockets.[34] And, therefore, collaboration with other countries to obtain a satellite or to jointly build one is a high-risk proposition and India can hardly afford to waste her scarce resources on diversified efforts with a high degree of uncertainty of a successful outcome. However, specific sub-systems may offer enough mutuality of interest as well as competence in certain other countries to warrant collaboration for such elements. The second alternative, namely, getting a U.S. satellite under U.N. auspices would clearly be unacceptable to the U.S. It is also known that multilateral ventures multiply the politics, delays and costs involved compared to a bilateral one. Leasing channels from an Intelsat satellite may not be feasible under the present quota system and it is very unlikely that it would be economically attractive under the present rates of tariff, though details of this have not been worked out. Moreover, these satellites are not designed for direct broadcast capability. Politically, it would be less acceptable to India, since she would have no control of it at all, unlike a dedicated satellite, which is used exclusively by one country. The fourth alternative, of developing a satellite indigenously, would take a long time, if the present rate of progress of the scientific rocket program is any indication. As K. C. Khanna observes, [34] "India has undoubtedly made a late start" in entering the field of space technology, considering the capabilities she is now aiming at. The first Indian-made Centaure (under a licensing agreement with France) was flight-tested in February 1969, several months behind schedule, and the success of the space program "critically depends on borrowed technology and gifted hardware". While India can certainly make efforts to develop the know-how for building a communication satellite, she cannot afford to wait for the expansion of television till such efforts come to fruition. Launch capability is still further away. Dependence on the U.S., therefore, seems to be the only feasible alternative for quite some time to come. Since the tariff is coming down for each generation of satellites, leasing channels from an Intelsat satellite is a possibility which merits greater examination. It is important for the U.S. as it is for India to ensure that the latter will be able to phase into an operational system after the ATS-F experiment concludes. If not, the whole venture would be highly disruptive and counterproductive in the long run. Since neither country would like to see some 2,000 darkened television sets sitting idle in the villages without a signal from any satellite after the experiment is over, there is an implicit commitment on the part of the U.S. to ensure that by some means or the other another follow-on satellite would be available to India, perhaps from a commercial source in the U.S. This may be a greater concern for the State Department than for NASA, which is essentially in the business of furthering space technology rather than providing an operational service, even within the U.S.

The State Department has many other concerns as well to worry about: for example, why should this joint experiment be done with India and why not some other developing country like Brazil or collectively with a host of Latin American countries? Though technical considerations already pointed out in Chapter 3 make the Indian case a strong one, foreign policy considerations clearly play at least an equally important part in arriving at the final decision. However, in this case, unlike any other technical assistance project, the incremental costs to the U.S. are negligible since NASA would launch the ATS-F satellite anyway, to perform other scientific missions. And it is only after completing these other tasks that the satellite would be sent over to the Indian Ocean area for the Indian television experiment. Once the other mission objectives are accomplished, it makes very little difference, from a scientific point of view, whether the satellite is over the U.S. or over any other place or even if it goes dead. Therefore, the political harvest to be reaped from the satellite is a pure bonus to the U.S. However, in all fairness, it must be pointed out that the initiative for the project and discussions with India, came from NASA, which recognized the opportunity of mutual interest opened up by direct broadcasting, and not the State Department, though presumably with the concurrence of the latter. Internal political considerations also have a bearing on the issue for the U.S. equally, as for India. For example, some responsible people in the U.S. feel that charity should begin at home and the ATS-F could better serve the under-privileged areas in the U.S. itself, like Alaska. But since such areas in the U.S. would need a more permanent operational system rather than a one-year experimental one, ATS-F does not turn out to be an attractive or efficient alternative to meet such internal requirements of the U.S.

On the positive side, making experiment time on the ATS-F available to India for conducting an experiment in instructional television for purposes of national development, is a unique and effective form of foreign aid, and it should help generate a great deal of goodwill. As it is a joint venture and helps India help herself, it does not create psychological feelings of inferiority or humiliation on the part of India, believed to be caused by food shipments. Instead, it should help bolster the image of both the countries - of India for using sophisticated technology to accelerate national development - and of the U.S. for sharing the benefits of the latest multi-billion dollar space technology with a less fortunate country. In view of the potential of satellite television, the experiment may prove to be of historic significance in revolutionizing the country's development, perhaps as no other single factor has ever done.

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